1) update material leaving site
2) f.ll ... business / security
3) theft.

REMEDIAL FEASIBILITY STUDY REPORT
PLANT SITE
FLORIDA GAS SITE
FLORIDA LOCATION, MICHIGAN

JULY 2001

Coleman Engineering

Civil Engineering • Environmental Engineering
Geotechnical Engineering • Land Surveying • Test Drilling
Construction Quality Control • Materials Laboratory Testing

REMEDIAL FEASIBILITY STUDY REPORT

PLANT SITE

FLORIDA GAS SITE

FLORIDA LOCATION, MICHIGAN

JULY 2001

PREPARED BY:

COLEMAN ENGINEERING COMPANY
635 Circle Drive
Iron Mountain, Michigan 49801

CEC Project #E-99001-F6

REMEDIAL FEASIBILITY STUDY REPORT
PLANT SITE
FLORIDA GAS SITE
FLORIDA LOCATION, MICHIGAN

Page No.

TABLES

FIGURES (See Plan Set)

APPENDICES

REMEDIAL FEASIBILITY STUDY REPORT
FLORIDA GAS PROJECT
PLANT SITE
FLORIDA LOCATION, MICHIGAN

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

Coleman Engineering Company (CEC) has been retained by Roy F. Weston, Inc. of Michigan (WESTON®) to conduct a Remedial Investigation (RI) and perform a Feasibility Study (FS) at the Florida Gas Site (FG Site), Florida Location, Michigan (Figure 1). **The FG Site consists of three (3) areas; the Plant Site, the Residential Drainage Ditch Site, and the Upper and Lower Wetland Site.** This Report pertains to the Plant Site. RI/FS work was conducted to delineate previously documented contamination in exceedance of the State of Michigan Natural Resources and Environmental Protection Act (NREPA), 1994, P.A. 451, as amended, Part 201 generic (Residential/Commercial I, Industrial/Commercial II, and Groundwater Surface Water Interface) criteria. cleanup complete (yr?)

The RI objective was to define the degree and extent of coal tar waste contamination that resulted from uncontrolled releases at the Plant Site. The RI fieldwork was conducted in two (2) phases. The RI fieldwork began in October 1999 and consisted of sampling the existing groundwater monitoring wells at the Plant Site. The RI fieldwork continued in the spring of 2000, and included soil sampling, installation of additional monitoring wells, and groundwater sampling.

The purpose of the Plant Site FS is to develop a range of distinct remedial alternatives and provide a basis for the selection of a remedial alternative. The goal of the selected remedial alternative will be to reduce/control migration, limit exposure to contaminated media remaining at the site, and provide adequate protection to human health and the environment.

The United States Environmental Protection Agency (USEPA) document, "*Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, October 1988,*" was used as a guide to complete this FS.

Contaminated media at the Plant [redacted]rily includes coal tar waste, soils and groundwater.' Site-specific remedial action objectives to protect human health and the environment were developed and general response actions, remedial technologies, and technology process options capable of meeting the objectives were identified. Once identified, the response actions, technologies, and process options were further evaluated based on effectiveness, implementability, and cost. Subsequently, feasible response actions, technologies, and process options identified for each media were combined into five (5) potential remedial alternatives for more detailed evaluation.

The potential remedial action alternatives encompass a range of treatment options from those that reduce the toxicity, mobility, or mass of the coal tar waste to options that involve measures to reduce exposure and migration potential. The remedial action alternatives also include options that vary in the degree to which long-term management of the site will be required and the level of aggressiveness associated with containment or reduction of contamination. A no-action alternative was also included.

The detailed analysis of the potential remedial alternatives included the evaluation of technical feasibility in the following terms: long-term effectiveness, short-term effectiveness, implementability, and restoration timeframe. Economic feasibility was also reviewed. The following sections of this report detail the FS process.

2.0 BACKGROUND INFORMATION

2.1 SITE LOCATION

The FG Site is located in the North 1/2 of Section 25 and the East 1/2 of Section 26, Township 56 North, Range 33 West, the Charter Township of Calumet, Village of **Laurium**, Florida Location, **[redacted]ty, Michigan** (Figure 1). The FG Site originates at the former Manufactured Gas Plant (MGP) on property currently owned by the Peninsular Gas Company (PGC) located near the intersection of Franklin Street and Lake Linden Avenue. Current owner ?

The FG Site consists of three (3) areas that are referred to in this report as the Plant Site, the Residential Drainage Ditch Site, and the Upper and Lower Wetland Site as displayed on Figure 1. The Plant Site, which this report documents, is located in the Northeast 1/4 of the Northwest 1/4 of Section 25, Township 56 North, Range 33 East. The Residential Drainage Ditch Site is within the Northwest 1/4 of the Northwest 1/4 of Section 25, Township 56 North, Range 33 East. The Upper and Lower Wetland Site is located in the Southwest 1/4 of the Northwest 1/4 and the Southwest 1/4 of Section 25 as well as portions of the East 1/2 of Section 26, Township 56 North, Range 33 East.

The Plant Site includes the former MGP (now owned by the PGC), roadway right-of-ways (ROWs) and surrounding private properties. **The Plant Site is bordered to the north and east by undeveloped w[redacted]nd to the south and west by residential neighborhoods.** The PGC property is a triangular shaped parcel between Franklin Street, Highway M-26 (Lake Linden Avenue) and Calumet Street. The drainage ditch, which received historic uncontrolled discharges of coal tar waste, is on the south side of the PGC property along Franklin Street.

It should be noted this report also includes data from two (2) monitoring well locations, **MW-13 and MW-25**, which are located within the Residential Drainage Ditch Site. Data from these monitoring wells are included in this document because they provide **downgradient** information.

2.2 ADDRESSES & CONTACTS

Regulatory Contact:

Ms. Amy E. Keranen
Michigan Department of Environmental Quality
Environmental Response Division
427 US 41 North
Baraga, MI 49908
(906) 353-6651

Department of Management & Budget
Project Management Firm:

Mr. Jeffrey S. Binkley
Roy F. Weston, Inc. of Michigan
P.O. Box 532
Houghton, MI 49931
(906) 482-7207

Professional Services Contractor:

Mr. Mark A. Gregory, CHMM
Mr. John T. Hunt, P.G., Ms. Helena L. Romin, P.E., Mr. Michael DesRosier, P.E.
Coleman Engineering Company
635 Circle Drive
Iron Mountain, MI 49801
(906) 774-3440

State Approved Contract Laboratories:

Mr. Michael L. Douglass
DLZ Laboratories, Inc.
1120 May Street
Lansing, MI 48906
(517) 374-9656

Mr. Ron Hamilton
BioChem Laboratories
1049 28th Street SE
Grand Rapids, MI 49508
(616) 248-4900

2.3 SITE HISTORY

In the early 1900s, a MGP was constructed to provide gas for residential, commercial, and municipal use in the Florida Location. The MGP was operated as the Calumet Gas and Coke Company until 1935, when its Articles of Incorporation were amended and the name was changed to the Peninsular Utilities Company. In 1946, the company name was changed to the Peninsular Gas Company (PGC). Between 1946 and 1947, the PGC converted from a coal gasification process to distribution of propane gas. In 1966, PGC switched to the distribution of natural gas, and utilized the propane plant only during periods of peak demand (most recently 1978). Presently, PGC distributes propane and operates the natural gas distribution system at the Plant Site.

During the use of the Plant Site as an MGP, numerous "by-products" and wastes were produced including: coal tars, tar-water emulsions, ash, clinkers, oxide box materials, lamp black, and process wastewater. [redacted]**stes, collectively referred to as "coal tar wastes", were discharged directly** [redacted]**drainage ditch adjacent to the Plant Site. Subsequently, the drainage ditch** [redacted] **waste through the Residential Drainage Ditch Site, the Upper and Lower W**[redacted]**, and ultimately Hammel Creek.**

Remedial and investigative activities have been completed at the FG Site in a phased approach. A chronology of these events is provided below:

- November 1992 – As a result of a Michigan Department of Environmental Quality (MDEQ)-Environmental Response Division preliminary site investigation, the FG site was included on Michigan's Sites of Environmental Contamination List.
- April 1993 – PGC initiated an investigation to confirm the existence of coal tar related contamination in excess of Michigan Department of Natural Resources (MDNR) Type B criteria at the FG Site.
- 1994 – PGC posted warning signs to alert residents to the presence of contaminated media within the Residential Drainage Ditch and Upper and Lower Wetland Site.

- 1996 and 1997 – PGC as well as the MDEQ completed further investigations of the FG Site.
- May 1998 – MDEQ requested the assistance of the USEPA in evaluating the feasibility of coal tar excavation from the Residential Drainage Ditch portion of the FG Site.
- July 1998 – The USEPA conducted test pitting and prepared a feasibility study for the Residential Drainage Ditch.
- October 1998 – The USEPA completed the report entitled *"Test Pit Excavation and Feasibility Study Report – Florida Gas Site"*, which concluded that the coal tar wastes and associated contaminated soil in the Residential Drainage Ditch could be excavated in a feasible cost-effective manner, with little inconvenience to the residents.
- December 1998 – The MDEQ retained WESTON® to provide project management services related to the remediation of the Residential Drainage Ditch and Remedial Investigation/Feasibility Studies (RI/FS) of the Plant Site and Wetlands. Subsequently, WESTON® retained CEC to serve as the Professional Services Consultant (PSC).
- March 1999 – WESTON®/CEC completed the RI/FS Work Plan for the upper wetland, *"Florida Gas Wetland RI/FS Work Plan"*.
- June 1999 - WESTON®/CEC conducted the upper wetland RI/FS and prepared the *"Florida Gas Wetland RI/FS Report (draft)"*.
- **June 1999** - WESTON® retained Moyle Construction, Inc. (Moyle) as the Trade Contractor to provide remedial services. WESTON®/CEC/Moyle remediated approximately **1,200 tons of coal tar waste and contaminated soil/sediment within the Residential Drainage Ditch**. In addition to removal of contaminated media, local infrastructure (streets, culverts, and utilities) was also removed and replaced. The remedial activities were reported in *"Florida Gas Ditch Remediation Documentation Report"* (February 2000).
- October/November 1999 - WESTON®/CEC completed the Work Plan for further investigation of the lower wetland and the Plant Site, *"Florida Gas Peninsular Gas*

Company Facility and West Wetland Remedial Investigation and Feasibility Study Work Plan".

- October 1999 - WESTON®/CEC completed groundwater monitoring at the Plant Site to develop current data that could be used to guide the additional RI activities.
- October 1999 through January 2000 - WESTON®/CEC completed RI activities in the lower wetland.
- February 2000 - WESTON®/CEC completed the summary report for the groundwater monitoring completed at the Plant Site in October 1999, *"Task 1 Groundwater Summary"*.
- March 2000 - WESTON®/CEC completed the draft report for the RI of the upper and lower wetland *"Wetland Remedial Investigation Report (draft)"*.
- April 2000 - WESTON®/CEC completed the report for the FS for the upper and lower wetland entitled *"Draft Remedial Feasibility Study Report, Upper and Lower Wetlands"*.
- March through May 2000 - WESTON®/CEC completed RI activities at the Plant Site.
- July 2000 - WESTON®/CEC completed the draft report for the RI of the Plant Site *"Draft Remedial Investigation Report"*.
- July 2000 – **Michigan Department of Community Health prepared a Draft Health Consultation for the site.**
- July 2000 - WESTON®/CEC completed the draft Plant Site FS entitled *"Draft Remedial Feasibility Study Report, Plant Site"*.
- December 2000 - WESTON®/CEC made revisions to the draft and completed the first final draft submittal of the RI for the Plant Site entitled *"Remedial Investigation Report"*.
- December 2000 - WESTON®/CEC made revisions to the draft and completed the first final draft submittal of the RI for the Upper and Lower Wetland Site *"Remedial Investigation Report"*.
- January 2001 – WESTON®/CEC made revisions to the draft and completed the first final draft submittal of the FS for the Plant Site entitled *"Remedial Feasibility Study Report, Plant Site"*.

- January 2001 – WESTON®/CEC made revisions to the draft and completed the first final draft submittal of the FS for the Upper and Lower Wetlands entitled *"Remedial Feasibility Study Report, Upper and Lower Wetlands"*.

2.4 REGULATORY STATUS OF THE SITE

The FG Site is included on the List of Michigan's Sites of Environmental Contamination. The site has been assigned an Assessment Model score of 44, pursuant to Part 201 of Michigan's NREPA, Public Act 451 of 1994, as amended.

Soil and groundwater contaminants have been identified at concentrations exceeding applicable generic NREPA, Public Act 451 of 1994, Part 201 Clean-up Criteria and Screening Levels as discussed in the following paragraph. From a groundwater regulatory compliance standpoint, it is recommended that permanent monitoring well data be used to evaluate the Plant Site saturated zone. During the course of the Plant Site RI, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, and ammonia were identified as contaminants of concern.

In order to quantify an extent of contamination, contaminant concentrations detected during laboratory analysis were compared to applicable clean-up criteria, as outlined in the June 7, 2000, MDEQ Operational Memorandum #18. The following general clean-up criteria were considered:

- Given the proximity of the contaminated unconfined upper aquifer to the bedrock aquifer currently in use as a potable water supply, soil and water contamination was screened with the applicable drinking water criteria.

- Given the presence of underground utilities and recreational use, direct contact of contaminated soils and groundwater is possible, therefore, direct contact criteria were evaluated.

- The site is proximate to wetlands and surface waters, therefore, groundwater/surface water interface (GSI) criteria were evaluated. Site-specific GSI protection (GSIP) criteria for several parameters were also calculated as per the procedure described in the MDEQ's Operational Memorandum #18, footnotes G and X, dated June 7, 2000.

- Metals contamination in soil was initially screened against the Statewide default background criteria.

- A site-specific background level for copper in soil was calculated.

- There are residential, commercial and industrial land uses within the area investigated as part of the Plant Site. For this reason consideration of applicable generic clean-up criteria and/or screening level comparisons was based upon the current land usage at a particular location. More consideration was given to generic Industrial/Commercial II, III, and IV criteria within the PGC property and within roadway ROWs. Residential/Commercial I criteria was given more consideration at or near residential properties.

- As a means of maximizing the usage of historic data, it was also necessary to make some assumptions with regard to observations made by others. It has been assumed that if others noted terms such as "highly contaminated", "gross contamination", "significant contamination", or "tar", then exceedances were likely and were viewed as such.

The results of the comparison between contaminant concentrations and applicable clean-up criteria, as noted above, provided an overall horizontal and vertical extent of soil and groundwater contamination, which is detailed in the Plant Site RI Report.

Given the nature of the coal tar waste, the overall **migration of VOCs/SVOCs/metals and ammonia appears to have been slow.** Slow migration of contaminants has been aided by the high organic carbon content of some of the underlying soils and an underlying dense till that is acting as a partial confining layer. More detailed discussion with regard to these topics is provided later in the report.

3.0 PHYSICAL AND GEOCHEMICAL SETTING

3.1 REGIONAL INFORMATION

The site is located in the Keweenaw Peninsula in Michigan's Upper Peninsula. The Keweenaw Peninsula trends in a southwest to northeast orientation, and is approximately 50 miles long and 20 miles wide. The Peninsula rises hundreds of feet above the surrounding Lake Superior, which is approximately 602 feet above mean sea level (MSL).

The Keweenaw Peninsula is geologically part of the Mid-Continent Rift, a major tectonic feature that was created approximately 1.1 billion years ago. The major stratigraphic units associated with the Mid-Continent Rift include the Portage Lake Lava Series, the Copper Harbor Conglomerate, the Nonesuch Shale, Freda Sandstone and the Jacobsville Sandstone.

The site is at an elevation of 1,185 feet MSL on the relatively flat plateau that runs down the center of the Keweenaw Peninsula. The plateau continues east from the site for 1½ miles where the land surface dramatically drops 500 feet to a Lake Superior lowland and Torch Lake.

The site is underlain by Precambrian bedrock of the Portage Lake Lava Series. These rocks are composed of a succession of more than 200 basaltic lava flows. There are conglomerate and sandstone occurrences interbedded within the basalt flows.

Naturally occurring metals are present both in the rocks and the resulting glacial till. Mineable quantities of native copper occur within the lavas and sedimentary rocks of the area. In addition to native copper, copper is also present in the form of chalcosite that occurred in fissures and veins near the main copper lodes and also within six (6) small deposits on the southeast side of the Keweenaw Peninsula. The largest of the chalcosite deposits is approximately 3 million tons in size and lies about 15 miles north of the site. In addition to native copper, chalcosite, copper oxide and other copper mineral species, the ore deposits of the Keweenaw Peninsula contain variable abundances of other metallic minerals. These minerals include: native Silver, galena (lead sulfide), sphalerite (zinc sulfide), stibnite (antimony sulfide) and various arsenides (Butler and Burbank 1929). The Centennial Mine lies approximately 2 miles north of the site. The Laurium shaft of Calumet-Hecla Mine lies to the northwest. There are no mineshafts known of within 1 mile of the site.

The Precambrian bedrock is overlain by an uneven blanket of surficial glacial debris deposited by glaciation during the Pleistocene Epoch. The last glacial activity to affect the area was the Wisconsinian Stage of glaciation, which occurred approximately 10,000 years before present. The glacially derived material includes moraine, till, outwash and lesser glacial-lacustrine material.

Soils in the area are derived from the glacial deposits as well as post-glacial peat and muck. The soil thickness on the Keweenaw Peninsula is variable. The glacial material was at least in part locally derived. It typically contains native copper and other metallic minerals derived by erosion and glaciation of the metal deposits hosted by the Portage Lake Lavas.

Surface water drainage is not well developed on the central plateau of the Peninsula. The region receives a tremendous amount of precipitation in the form of snow during the winter months as well as heavy rains during the rest of the year. There are numerous areas of wetland as a result of the heavy precipitation. Most drainage occurs via numerous small streams that discharge into Lake Superior.

Hydrogeology in the region consists of glacial overburden and bedrock aquifers. Both glacial and bedrock aquifers are used as a source of potable water. The quality and quantity of groundwater is extremely variable in both glacial overburden and bedrock formations. However, in most locations, wells suitable for domestic use can be drilled successfully.

3.2 SITE SPECIFIC GEOLOGIC CONDITIONS

The Plant Site is at an elevation of approximately 1,185 feet MSL and surface topography is relatively flat to the north, rises to the east and west, and gently slopes overall down to the south. The Residential Drainage Ditch flows through residential areas to the south.

Field notes and laboratory descriptions from previous RI efforts indicate relatively homogenous geologic conditions across the Plant Site and surrounding area. In general, the upper several feet of overburden consist of sand and gravel fill material. At several locations building rubble, coal, cinders, and rubbish were noted in the fill material. Occasionally, a thin layer of peat/organic silt was observed underlying the fill material. In many instances, a brown fine sand of varying thickness and silt was observed beneath the fill material. The sand/silt unit is underlain by an extremely dense, calcareous reddish brown or gray silty sand with varying amounts of gravel and cobbles/boulders. This glacial till formation was generally encountered between 15 and 20 feet below ground surface (BGS). Based on seismic refraction and previous drilling, the top of this till was interpreted to be the apparent bedrock interface.

Bedrock underlying the area is late Precambrian Portage Lake Lava Series, more specifically, a flood basalt located deeper in the area geology. The topography of the bedrock surface in the region is extremely variable. During CEC's investigation efforts bedrock was encountered in two (2) boreholes between 45 to 55 feet BGS and in one (1) borehole bedrock was not encountered in nearly 80 feet of drilling.

3.3 SITE HYDROGEOLOGIC CONDITIONS

Groundwater at the site was encountered at shallow depths in all borings. The direction of groundwater flow in close proximity to the existing drainage ditch appears to be different for the shallow and deeper groundwater intervals. Groundwater elevation data indicates that shallow groundwater flow direction is controlled by groundwater flowing towards and discharging to the Residential Drainage Ditch. Shallow groundwater from north and south of the ditch flows towards the drainage ditch. This includes the shallow groundwater south of Franklin Street, which flows in a northerly direction, also toward the ditch.

Groundwater elevation data from deeper wells does not appear to be influenced by the drainage ditch. A total of seven (7) deep monitoring wells (MW-16D, -18D, -20D, -35D, -37D, -39D, -42D) were installed at the Plant Site with screens placed approximately 20 feet BGS. At this depth, the wells are screened across the top of the dense glacial till unit and part of the lower sand/silt unit. **Groundwater elevation data from these wells indicate flow is in a southwest direction.**

Horizontal and vertical hydraulic gradients calculated as part of RI activities indicate horizontal hydraulic gradients ranging from 0.044 ft/ft to 0.079 ft/ft and vertical hydraulic gradients ranging from 0.18 ft/ft in a downward direction to 0.034 ft/ft in an upward direction.

3.4 SURFACE WATER RUN-OFF CONSIDERATIONS

The Plant Site is hydraulically downgradient of a wetland area adjacent to the north and east. Surface water from the wetland is conveyed through the Residential Drainage Ditch on the south side of the Plant Site. Precipitation ponding also occurs on some areas of the site, most notably directly east of the maintenance building and along Calumet Street. Any remediation activities will require management of the surface water entering the site.

3.5 WETLAND CONSIDERATIONS

The presence of wetlands requires additional regulatory and geochemistry consideration.

3.5.1 Regulatory Considerations

Michigan's wetland statute, Part 303, Wetlands Protection, of the NREPA, 1994, Public Act 451, as amended, defines a wetland as "land characterized by the presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation or aquatic life, and is commonly referred to as a bog, swamp, or marsh." The definition applies to public and private lands regardless of zoning or ownership. The upgradient wetland area meets this definition, and is therefore subject to wetland regulations.

Current regulations require persons planning to conduct certain activities in regulated wetlands obtain a permit before beginning the activity. A permit is required from the state for the following:

- Depositing or the placing of fill material in a wetland.
- Dredging or removing soil or minerals from a wetland.
- Constructing, operating, or maintaining any use or development in a wetland.
- Draining surface water from a wetland.

Before a permit can be issued, the following will typically need to be determined:

- The permit would be in the public interest.
- The permit would be otherwise lawful.
- The permit is necessary to realize the benefits from the activity.
- No unacceptable disruption to aquatic resources would occur.
- The proposed activity is wetland dependent or no feasible and prudent alternatives exist.

Potential remedial activities likely fall under the list of permit-required actions and will involve MDEQ Land and Water Management Division consideration. More rigorous remedial actions may also require wetland mitigation.

3.5.2 Geochemistry

The Plant Site is situated in a setting that was historically a wetland. Although there is an upgradient wetland present to the north, much of the rest of the site has been filled. In some instances a peat/muck layer was encountered in soil borings conducted at the site. This is most likely the former surface layer of the wetland setting that was present prior to the filling and construction at the site. The geochemistry at the site is somewhat similar to an unfilled wetland, being anaerobic in nature with reduced indicator parameters. Ammonia concentrations are high with no presence of nitrates as would be expected in an anaerobic environment. Sulfides rather than sulfates are present, indicating that these species are also completely reduced, i.e. undergoing anaerobic reduction processes.

4.0 DEGREE AND EXTENT OF CONTAMINATION

The following section summarizes CEC's general conclusions with regard to soil and groundwater contamination. This summary includes both historic and recently obtained data. A detailed review of the site information can be found in the Plant Site RI Report.

The following figures are included in this report to aid in describing the extent of contamination:

- Figure 2 – Site Location Map – Project Area by Section
- Figure 3A – Estimated Horizontal Extent of Soil Contamination
  March/April 2000 Data
- Figure 3B – Comparison of Detected Soil Sample Analytes to
  Part 201 Screening Criteria - March / April 2000 Data
- Figure 3C – Estimated Horizontal Extent of Soil Contamination
  Evaluated Historical Data
- Figure 3D – Comparison of Select Historical Soil Samples to
  Part 201 Screening Criteria
- Figure 4A – Estimated Horizontal Extent of Groundwater Contamination
  October 1999, April / May 2000 Data
- Figure 4B – Comparison of Select Groundwater Samples to
  Part 201 Screening Criteria

Appendix A contains historic site maps that are referred to in this section.

CEC collected the more current RI data. However, the conclusions are based upon current data, historic data, site observation, field analyses obtained from previous RI efforts, and review of historic files. Consequently, it was necessary for CEC to make certain assumptions with regard to the assessment of the degree and extent of contamination.

Several terms are used in this report to characterize the degree of contamination. These terms include "**highly contaminated soil**" that refers to soil with observations of coal tar, oil and/or multiple VOC, SVOC and metals clean-up criteria exceedances. "**Moderately contaminated soil**" refers to soil with visual impact (discoloration, sheen), odors and/or few VOC, SVOC and metals clean-up criteria exceedances. "**Contaminated shallow fill**" refers to shallow fill material with no visual evidence of coal tar waste but with low-level VOC, SVOC, and/or metals clean-up criteria exceedances.

Given the different areas land uses, the variability and the quantity of information present in the data set, summary information on the extent and concentration of soil or groundwater is presented on a section-by-section basis. Reasoning for the degree of contamination thought to be present in each section is also provided.

The summary information was also divided due to the presence of different applicable criteria based on current land use. All of the sections were evaluated for groundwater/surface water interface related criteria for soil and groundwater.

4.1 SOIL CONTAMINATION SUMMARY

To identify areas of soil contamination, the Plant Site was broken into separate sections based on current land use, location, and presence of contamination as follows:

- The PGC property (Sections 1, 2, 3, and 4) screened with the Industrial/Commercial II criteria.

- Street ROWs (Sections 5, 6, and 7) screened with the Industrial/Commercial II criteria.

- Residential Properties (Sections 8, 9, 10, and 11) screened with the Residential/Commercial I criteria.

- All Sections (1-14) were screened with the Groundwater/Surface Water Interface Protection criteria.

Within sections where Industrial/Commercial II criteria are more applicable, residential criteria exceedances may be present but were not discussed in detail. Figure 2 displays these sections. Figures 3A – 3D display both recent and historic sample locations and analytical data.

4.1.1 PGC Property Sections - Industrial/Commercial II

<u>4.1.1.1 PGC Property – Western Section[redacted] 1)</u>

The area is shown as Section 1 on Figure 2. Based on the available information, Section 1 is the least contaminated section on the PGC property. Soil data for this section is limited to four (4) locations with laboratory analysis (Test Pits TP-7 and TP-7A/recent soil borings PB-110 and PB-111). The conclusions presented are, therefore, based in part on site observations.

Much of this section appears to have been filled by deposition of ash and slag possibly from the former MGP operation. Multiple references to ash and slag were noted in the following samples (GP-2-22, GP-2-23, GP-2-24, GP-2-26, GP-2-35, and GP-2-38).

Soil samples with VOC and SVOC analyses in the area were collected from TP-7, TP-7A, PB-110, and PB-111 at a depth of [redacted] **1 feet BGS**. The data indicates that SVOC, metals, cyanide, and ammonia concentrations exceed GSIP criteria. **No industrial criteria exceedances** were noted.

Review of observations indicates that greater contaminant concentrations may be present in this section. Consideration was given to the multiple observations made at deeper locations (up to 5 feet BGS) with reference of light to strong odor (GP-2-35, GP-2-23, GP-2-24, GP-2-26, GP-2-22, GP-2-25, and GP-2-28). Since the soil samples collected from TP-7 and TP-7A were collected from depths of 0 to 1 feet BGS, it is possible that greater concentrations of contamination could be present at depth. This conclusion is supported by SVOC data from downgradient PB-108 at 2 to 4 feet BGS that is greater in concentration than the samples from TP-7 or TP-7A. This suggests that industrial and GSIP criteria exceedances are likely present in this area.

Two (2) sample locations (GP-2-27 and GP-2-36) within this section also make reference to the presence of tar. Contamination noted in GP-2-27 is likely related to the adjacent drainage ditch along the southern edge of the section. There is no information suggesting the source of the tar observed in GP-2-36.

4.1.1.2 PGC Property – Propane ASTs (Section 2)

Section 2, displayed on Figure 2, includes an alley ROW. At this time it is not known if the alleyway has been vacated.

Due to underground utilities, investigation in this area has been limited. Based on analytical data from surrounding sections it is assumed that contamination originating at the Middle Section of the PGC property (Section 3) has migrated underneath this area from the upgradient location near the former tar tank and the Propane Air Mix Plant. Observations from GP-2-20 and GP-R2 suggest coal tar is likely present at least in some part on the southern edge of this section.

4.1.1.3 PGC Property – Middle Sectio[redacted]n 3)

Section 3 generally extends from the northern edge of the property near the historical MGP building location to the drainage ditch adjacent to the southern PGC property boundary as shown on Figure 2.

Both historical and recent observatio[redacted] the presence of coal tar waste from the surface to [redacted].' Soil samples were collected by PGC along the western edge of the existing Maintenance Building, near test pits TP-5 and TP-6, and in the vicinity of the existing Propane Air Mix Plant. Soil samples were also collected from the MW-46 boring location in April 2000. The existence of part of the former underground tar tank as shown on the 1917 site features map in Appendix A-2, was confirmed during the completion of the TP-5 test pit based on observation. **The extent of coal tar in this area is unknown due to structures preventing subsurface investigative efforts.** The potential of coal tar contamination underlying the structures should be noted.

Soil samples were collected from MW-46, GP-2-18, GP-2-19, GP-2-87, and GP-2-89 and submitted for both VOC and SVOC or naphthalene analyses. Soil sample analysis data indicates industrial direct contact, industrial indoor air and GSIP exceedances for VOCs and SVOCs. Metals, cyanide and ammonia concentrations exceed the GSIP criteria.

Most of the remaining soil data (GP-2-13, GP-2-14, GP-2-12, TP-5, TP-6, GP-2-84, GP-2-85, GP-2-86, GP-2-17, GP-2-20, GP-R2, and GP-R3) for this area includes observations, limited VOC scans and gas chromatography/mass-spectroscopy (GC/MS) screening analysis. Given the relative concentrations of available parameters compared to similar data from soil samples from MW-46, GP-2-18, GP-2-19, GP-2-87, and GP-2-89; industrial direct contact, industrial indoor air and GSIP criteria exceedances are also likely to be present in these locations.

4.1.1.4 PGC Property – Eastern Section (Section 4)

A second area of highly contaminated soils on the PGC property, denoted as Section 4 on Figure 2, is located in the eastern corner of the property near the locations of a former 8,000 gallon crude oil tank and two (2) oil storage tanks. The former 8,000 gallon crude oil tank is shown on the 1917 site features map in Appendix A-2. The two (2) oil storage tanks are shown on the 1946 site features map in Appendix A-3. Historically, this area also included a railroad corridor, the former coal storage shed (1908 & 1917), the charging room/platform and tank car unloading area (1946), and a 35,000 cubic foot gas holder (1908, 1917, 1946).

Soil samples within Section 4 were collected by PGC to the east of the Maintenance Building in the vicinity of the aforementioned former oil and crude oil tanks, and along the western and southern edge of the Maintenance Building. The recently collected soil samples from PB-102 are also included in this section. Observations from GP-2-42, GP-2-33, GP-2-34, GP-2-80, GP-2-79, GP-2-30, GP-2-1, and GP-2-76 indicate "grossly" contaminated conditions from approximately 3 to 8 feet BGS. None of these borings were advanced deeper than 8 feet BGS.

Of this set of soil sample locations, borings GP-2-42, GP-2-79, and GP-2-30 make reference that "tar" was encountered. Observations made at soil sample locations; GP-2-33, GP-2-34, GP-2-80, GP-2-1, and GP-2-76 were noted as grossly impacted oily coarse sand, grossly contaminated oily rock fragments, strong odor with stained sand, sheen, and grossly impacted oily sand, respectively. As identified above, oil was formerly stored in the vicinity of these sample locations. Based on the "oily" reference, commingled contamination may exist in this area.

Observations from GP-R1 and samples collected by CEC during sampling activities associated with the drainage ditch remediation revealed that contamination present to the south of this section was slightly more fluid in nature. These observations also indicate that **contamination from this area migrated south to the drainage ditch.**

Given the observations of contamination in borings GP-2-84, GP-2-85, and GP-2-86, there may be coal tar/oil contamination underneath the existing Maintenance Building from this upgradient source. It is currently unknown if contaminant mobility is limited by the Maintenance Building foundation or other historic underground structures present at the site.

Soil borings GP-2-6 and GP-2-7 indicate that contamination exists slightly to the north, of the Maintenance Building.

Much of the assessment of contamination in this section is based on observations and in-field VOC analysis completed with GC/MS. Of the two (2) soil borings with complete

VOC and SVOC laboratory analyses, soil boring PB-102, completed in March 2000, indicates that only cyanide and ammonia exceed the GSIP criteria. However, samples from soil boring GP-2-1 which were completed in the vicinity of the highly contaminated area, indicate that there are SVOC industrial direct contact criteria exceedances and GSIP exceedances for VOCs, SVOC, metals, and ammonia.

Comparison of GP-2-1 VOC results to other soil samples with limited VOC and, in one case, naphthalene analysis (GP-2-76, GP-2-79, and GP-2-80) indicates that VOC concentrations in these samples are similar if not greater in concentration than those found in GP-2-1. It is likely that both oil or coal tar contamination would predominantly consist of the more heavy molecular weight contaminants. Hence, industrial direct contact and volatilization to indoor air exceedances are plausible in much of the area noted as being visually affected. These exceedances may also exist under the Maintenance Building.

4.1.2 Street Right-of-Way Sections - Industrial/Commercial II

There are established street ROWs within the Plant Site. The street ROWs are under the jurisdiction of the Houghton County Road Commission (HCRC) and the Michigan Department of Transportation (MDOT). Three (3) distinct sections, Sections 5 through 7, represent the street ROWs.

4.1.2.1 The Drainage Ditch and Franklin Street ROW (Section 5)

The drainage ditch and the Franklin Street ROW lie immediately south of the PGC property and are presented as Section 5 on Figure 2. It should be noted that in 1999 interim response actions were conducted in the residential drainage ditches (*Florida Gas Drainage Ditch Remediation Documentation Report, Florida Location, Michigan, February 2000*) that resulted in the reduction of coal tar waste from the ditch. The area excavated during this remediation effort is shown on Figure 2.

Review of the soil sample analysis data pertaining to FS-118 through FS-123 and FS-125 through FS-130, collected during the drainage ditch verification of soil remediation (VSR) sampling indicates that mainly GSIP criteria exceedances for VOCs, SVOCs, metals, and ammonia remain in the unexcavated portions of the drainage ditch located within the Plant Site. Observations made during ditch remediation activities indicate that coal tar waste remains along the northern side of the excavated area along the PGC property, and that industrial criteria exceedances in this location are presumed to exist.

It should also be noted that a portion of the drainage ditch that was not excavated during the 1999 remediation efforts is present in Section 5. The unexcavated portion is located along the culverts designed to direct surface water flow under Highway M-26. Based on available data collected along the drainage ditch in this area, it is anticipated that industrial criteria exceedances are present in this area.

Section 5 also focuses on the part of the Franklin Street ROW that does not contain the drainage ditch. Soil samples collected by MDEQ south of the drainage ditch in the street or at depths greater than 4 feet BGS within or near the drainage ditch (MDEQ – SS14/SS15, SS31/SS32, SS34, SS29/SS30, and SS24/SS35) indicate that soil exceedances are limited to GSIP and some residential drinking water protection (RDWP) criteria exceedances for VOCs, SVOCs and ammonia.

Soil samples collected nearest to the Franklin Street Residential Section 10 (MDEQ SS24/25, GP-L24, GP-L23) indicates that VOC contamination may extend onto the residential area. This is discussed further in Section 4.1.3.3.

4.1.2.2 Highway M-26 ROW (Section 6)

This section is bounded to the north by the driveway ROW north of and adjacent to the western edge of the PGC property. The section is bounded to the south by the drainage ditch and to the west by the Highway M-26 Residential Section. Refer to Figure 2 for a more specific review of the location of this section.

Soil samples collected in this section are limited to those collected recently, PB-107 and PB-108. Soil sample results from PB-107 indicate that soil contamination is limited to metals and ammonia, with GSIP criteria exceedances for cyanide and ammonia. Soil sample analysis results from PB-108 (2 to 4 feet BGS) indicate GSIP criteria exceedances for SVOCs, metals, and ammonia.

4.1.2.3 Street ROW North of the PGC Property (Section 7)

This area is depicted as Section 7 on Figure 2, and lies immediately to the north of the PGC property. The section serves as the limits of coal tar/oil contamination on the north end of the Plant Site.

Observations of coal tar or oil were noted in soil samples GP-2-16, GP-2-6, and GP-2-7. Laboratory analysis from GP-2-6 indicates that RDWP criteria, direct contact, and GSIP criteria are exceeded for VOC's, SVOC's, cyanide, and ammonia.

Recently installed borings (PB-105, MW-39D, and MW-44) in the western part of this section indicate VOC/SVOC contamination is present in MW-39-D at 6 to 8 feet BGS with only GSIP criteria exceedances. The remaining soil samples have exceedances for ammonia and some metals. Industrial criteria exceedances have not been identified in this section.

4.1.3 Residential Sections – Residential/Commercial I

4.1.3.1 Western Upgradient Wetland (Section 8)

This area is presented as Section 8 on Figure 2 and lies immediately north of Section 7 and to the west of the existing railroad grade. Historical information indicates that this area was the former site of a supply warehouse adjacent to the railroad, as shown on the 1917 and 1946 site features maps presented in Appendices A-2 and A-3.

Historical samples collected in the northern part of the area (GP-2-50, GP-2-56, GP-2-54, GP-2-55, GP-2-75) indicate no visual evidence of soil contamination.

The recent soil sample location PB-109 only has GSIP criteria exceedances for ammonia and no residential criteria exceedances.

The historical sample GP-2-59 and recent sample PB-101 indicate the existence of an area of shallow fill approximately 1 to 2 feet thick. GP-2-59 has GSIP criteria exceedances for metals and one (1) SVOC with two (2) RDWP criteria exceedances for chromium and cyanide. Additional SVOCs, although detected, do not exceed the applicable generic clean-up criteria. The PB-101 boring location, however, has RDWP, residential direct contact (RDC) and GSIP criteria exceedances for SVOCs, metals and ammonia. This is likely due to the proximity of the sample to the suspected location of the former warehouse.

4.1.3.2 Eastern Upgradient Wetland (Section 9)

This area is presented as Section 9 on Figure 2 and lies immediately north of Section 7 and to the east of the existing railroad grade. Most of the soil samples collected in this area displayed no visual evidence of soil contamination.

Of the soil samples with evidence of contamination (GP-2-58, GP-2-48, GP-2-60, and the recently installed MW-34 and PB-103), soil exceedances are limited to GSIP criteria exceedances for cyanide and ammonia with one (1) RDWP criteria exceeded. Soil sample GP-2-60 had multiple detections of SVOCs. Boring location PB-103 had a RDWP criteria exceedance for pyridine at 2 to 4 feet BGS. Contamination may be related in part to historically imported fill and the railroad operations.

4.1.3.3 Franklin Street Residential Section (Section 10)

This area is shown as Section 10 on Figure 2 and lies directly south of the Franklin Street ROW. Observations of the soil borings indicate a shallow layer of fill including fragments of coal and ash from approximately 0 to 2 feet BGS.

Samples collected from this depth have some metals/cyanide detections with limited GSIP criteria exceedances. SVOCs were also detected in one (1) sample (PB-106), with a GSIP criteria exceedance for phenanthrene, which may be attributed to the presence of coal. VOCs detected at deeper locations just to the north of the section in the MDEQ samples in the Franklin Street ROW were not present in these samples and did not result in any clean-up criteria exceedances.

Ammonia soil contamination above the GSIP criteria begins at ground surface with the greatest concentration reported at approximately 28.5 feet BGS.

4.1.3.4 Highway M-26 Residential Section (Section 11)

This area is presented as Section 11 on Figure 2. This section is identified mainly for the consideration of groundwater contamination. While no soil samples were collected in this area, the upgradient soil sample PB-107 had GSIP criteria ammonia exceedances. As shown on Figure 2, this section does not include the part of the ROW containing the Franklin Street intersection, the drainage ditch, and associated culverts.

4.2 GROUNDWATER CONTAMINATION SUMMARY

Groundwater contamination was evaluated in a similar fashion as the soil contamination. The Industrial/Commercial II criteria were used on the PGC property and in the street ROWs and Residential/Commercial I criteria were used in the residential areas.

The area of groundwater contamination generally corresponds to the area of soil contamination. Since most of the soil contamination is shallow, groundwater contaminant concentrations are greatest in the shallow groundwater monitoring wells screened in the fill and upper silty sand material overlying the calcareous glacial till in the highly contaminated soil locations. The monitoring wells screened deeper in the silty sand layer directly above or partially in the glacial till exhibit much less groundwater contamination. On-site bedrock well groundwater data indicate a few metals exceedances. Water table monitoring wells upgradient to the highly contaminated soils have little or no contamination present. It should be noted that shallow groundwater flow direction is influenced by the drainage ditch. There also is little to no groundwater contamination present in the deeper wells in these locations.

4.2.1 PGC Property and Street ROWs – Industrial / Commercial II

Sections 1 through 7 on Figure 2 were evaluated using the industrial and groundwater surface water interface screening criteria. However, due to groundwater migration potential, residential criteria were also evaluated. Groundwater contamination on the PGC property and in the ROWs exceed industrial, residential, and GSI criteria for VOCs, SVOCs, metals, cyanide, and ammonia.

Since VOC and SVOC contamination is an indicator of highly contaminated areas, they are the focus of the evaluation to determine what areas may require remedial action.

The area of greatest groundwater contamination appears to be related to the soil contamination present in Section 3, possibly due to the former underground tar tank. Groundwater data from MW-46, MW-17, and MW-18 indicates that VOCs and SVOCs are present in groundwater near this location, with MW-46 and MW-17 having exceedances of industrial and residential criteria.

Sample data from MW-19, MW-20, PB-102, and GMW-1 indicate that VOC and SVOC contamination is also present near Section 4, with industrial criteria exceedances in MW-19 and GMW-1.

VOC and SVOC groundwater contamination present in GMW-3, MW-42D, and MW-43 appears to be related to the drainage ditch. VOC exceedances in MW-15 and MW-16 could also be related to the drainage ditch, but may also be affected by upgradient contamination from Sections 1, 2, 3, and 4.

VOCs were also detected in MW-40 and MW-39D, with GSI criteria exceedances present in MW-40. This may be related to documented contamination in Sections 1 and 3 due to the shallow groundwater gradient, but may also be related to the former supply house.

Residential criteria exceedances for cyanide, metals, and/or ammonia were detected in PB-107, MW-44, PB-105, and PB-108. Samples MW-41 and MW-49 had no exceedances.

Shallow groundwater contamination present in the vicinity of the drainage ditch is likely to migrate in the direction of groundwater flow towards the ditch.

4.2.2 Residential Areas – Residential / Commercial I

Groundwater samples collected in the residential areas can be divided into two (2) groups, those collected north of the PGC property in Sections 8 and 9 on Figure 2; and those collected south of the Franklin Street ROW in the Franklin Street Residential Area (Section 10 on Figure 2).

Groundwater samples collected from Sections 8 and 9 include sample locations PB-101, PB-103, PB-109, MW-21, and MW-34. Bis(2-ethylhexyl)phthalate was reported at PB-109 in exceedance of the RDW industrial drinking water and GSI criteria. This is suspected to be a laboratory contaminant, as there are no other VOC or SVOC detections in the sample or any other soil samples from the boring. No other exceedances were present.

Migration of contaminants to Sections 8 and 9 is limited because they are upgradient of the PGC property and contain high organic content type soils.

Groundwater samples were collected from Section 10 at PB-106, MW-35D, MW-36, MW-38, and MW-41. Chromium exceeded the GSI criteria at MW-38; however, no other exceedances were noted. VOC and SVOC contaminated soil is present along the southern edge of the Franklin Street ROW; however, it is unlikely that shallow groundwater contamination would migrate into the residential area because shallow groundwater flow direction is towards the drainage ditch.

Although no groundwater samples were collected in the Highway M-26 Residential area (Section 11), it is possible that VOC, SVOC, metals and ammonia exceedances exist.

Analytical data from upgradient monitoring wells MW-15, MW-16, MW-42 and MW-43D further suggest that contaminated groundwater may be present in this location.

5.0 RISK ASSESSMENT

This preliminary risk assessment provides an evaluation of the potential threat to human health and the environment in the absence of any remedial action and the short-term risks associated with intrusive activities. The assessment of risk is based upon generic NREPA Part 201 criteria as outlined in the June 7, 2000 Operational Memorandum #18.

5.1 HUMAN HEALTH (SOIL)

Within the Plant Site human exposure scenarios have been identified. The two (2) exposure settings are related to industrial and residential exposure.

The Plant Site assessment of risk is based upon current land usage. Historical land usage at the Plant Site and the actual local land use zoning may be different. Refer to Figure 2 for review of the relative location of each of the identified areas.

5.1.1 PGC Property

Risk associated with human exposure at the PGC property was evaluated relative to an industrial setting. The two (2) generic NREPA Part 201 industrial criteria applied were direct contact and volatilization to indoor air.

5.1.1.1 Industrial Worker Direct Contact

Within the boundaries of the PGC property, the most applicable exposure related to direct contact with contamination is by an industrial worker. It is plausible that there are industrial worker type activities that could result in an exposure to existing contamination. Typical industrial worker activities that could result in direct contact exposure include subsurface construction work and underground utility repairs or extensions.

Industrial direct contact criteria exceedances for VOCs and SVOCs have been documented on the PGC property through laboratory analysis data and are presumed to exist on the basis of observations. Sections 3 and 4, as shown on Figure 2, represent the locations where direct contact exposures are considered the greatest.

Although expected to be less than in other areas on the Plant Site, portions of Section 1 and Section 2 likely have industrial worker direct contact exceedances. This is based on observations and the proximity of identified industrial direct contact exceedances in adjacent sections.

5.1.1.2 Industrial Volatilization Indoor Air

Due to the presence of contamination, an exposure risk through volatilization to indoor air may exist in building locations on the PGC property, as shown on Figure 2.

In addition, future expansions or renovations on the PGC property could result in exposures to industrial workers through inhalation of indoor air.

5.1.2 Street Right of Ways

Typical exposure scenarios that are reasonably expected within street ROWs would normally be associated with area infrastructure upgrades or repair. Consequently, risk associated with exposure within established street ROWs was evaluated relative to generic NREPA Part 201 industrial direct contact criteria.

5.1.2.1 Industrial Worker Direct Contact

Within the identified street ROWs, the most applicable exposure related to direct contact with contamination is by an industrial worker conducting subsurface work. It has been assumed that the primary intrusive activities resulting in exposure would include utility repairs/extensions, street repairs and/or drainage ditch modifications.

Industrial worker direct contact considerations are greatest along the northern bank of the drainage ditch immediately adjacent to the southern boundary of the PGC property. This portion of the drainage ditch was not excavated during the 1999 drainage ditch remediation project due to the limitations of the site access agreement with PGC and the practical limits of excavation.

In addition, the culvert that crosses M-26 was not removed during the 1999 drainage ditch remediation project. Significant coal tar waste likely remains in place along (within Section 5) and in near proximity (within Section 6) to the buried culvert. Industrial direct contact exposure considerations are reasonable to assume on the basis of observations made during the 1999 drainage ditch remediation.

Limited industrial direct contact considerations may also exist along the southern border of Section 7 immediately adjacent to Sections 3 and 4 of the PGC property. This exposure consideration is based on the proximity of coal tar waste presumed to exist on the PGC property.

5.1.3 Residential Properties

Potential risk associated with exposures on residential property was evaluated relative to two (2) generic NREPA Part 201 residential criteria; direct contact and volatilization to indoor air.

5.1.3.1 Residential Direct Contact

SVOC RDC criteria exceedances were present for SVOCs in the southern portion of Section 8 and cyanide in the southwestern portion of Section 9. It should be noted that amenable cyanide analysis on the sample collected was reported as non-detect. Amenable cyanide is a measure of reactivity to chlorination and was used to quantify the reported cyanide concentration for compliance to the RDC. **There was also an RDC criteria exceedance for benzo(a)pyr[redacted]entral portion of Section 10.**

There is a vegetative cover on nearly all residential properties and unless there are intrusive activities, direct contact is limited and therefore is assumed to be minimal.

5.1.3.2 Residential Indoor Air Volatilization

Residential indoor air volatilization criteria exceedances have not been documented in Sections 8, 9 or 10.

5.2 HUMAN HEALTH (GROUNDWATER)

The Plant Site assessment of risk related to groundwater is based upon current land usage and that **potable water within the area investigated is provided through a municipal water** supply system. Historical land usage around the Plant Site and actual local land use zoning may be different.

5.2.1 PGC Property and Street ROW

5.2.1.1 Drinking Water Criteria

SVOC, VOC and metals contamination exists across the PGC property and portions of the surrounding street ROWs. Soil samples collected indicate that RDWP criteria are exceeded. This suggests that concentrations in the highly contaminated areas are great enough to pose a threat to the upper aquifer if used as potable water. Actual groundwater data within these areas also shows some RDW criteria exceedances. Below an approximate depth of 20 feet in the confining calcareous glacial till and deeper, groundwater contamination does not appear to be present. Upper aquifer monitoring well data also indicates that groundwater within the overburden would be cause for drinking water exposure considerations. The collected information also shows that the quality of the upper aquifer in the overburden significantly improves a short distance from the area of greatest contamination (Sections 3 and 4).

5.2.1.2 Direct Contact

Direct contact criteria exceedances in groundwater are present in the southeast portion of Section 4 and the western portion of Section 7 immediately adjacent to Section 2. Given the visual evidence of significant contamination, it is also likely that direct contact criteria exceedances exist in Section 3.

5.2.1.3 Industrial Indoor Air Volatilization

There have been no industrial indoor air volatilization criteria exceedances documented in groundwater on the PGC property or within the surrounding street ROWs. Exposure through inhalation of industrial indoor air volatilization is a plausible consideration; based upon observations of significant impact in the proximity of existing structures.

5.2.2 Residential Properties

5.2.2.1 Drinking Water Criteria

Laboratory sample analysis documents RDWP criteria exceedances for SVOCs and metals in the southern portion of Section 8 and the southwestern portion of Section 9. The RDWP criterion has not been noted as being exceeded in Sections 10 or 11.

Permanent monitoring well data pertaining to the residential areas of the Plant Site indicates that groundwater within the upper aquifer in the overburden would present a very limited drinking water exposure concern. On the basis of flow direction and the laboratory data pertaining to the monitoring wells MW-15, MW-16, MW-42D and MW-43, a portion of Section 11 may have contaminated groundwater. However, any contamination in Section 11 is likely to be limited. To aid in determining exposure risks in Section 11, it may be necessary to install an additional well in this section.

Although a limited number of temporary monitoring wells were installed during site activities, the temporary well data was not used in this risk assessment, because it is not considered to be as representative as the data obtained from permanent monitoring wells.

5.2.2.2 Direct Contact

There were no RDC criteria exceedances documented in groundwater on the residential properties of the Plant Site.

5.2.2.3 Indoor Air Volatilization

There were no residential indoor air volatilization criteria exceedances documented in groundwater on the residential properties of the Plant Site.

5.3 DESCRIPTION OF HUMAN EXPOSURE SCENARIOS

5.3.1 Industrial PGC Property Operations

Within the boundaries of the PGC property the most plausible exposure related to direct contact with soil and groundwater contamination would be an industrial worker involved in existing industrial operations. Industrial worker activities that could result in direct contact exposure include subsurface construction work and underground utility repairs or extensions. A "No Action" alternative would not result in any decrease in risk of industrial worker direct contact exposure.

An exposure risk through inhalation of contaminated indoor air may also exist and is considered greatest on the PGC property. Given the limited data, potential for exposure through inhalation of indoor air should be evaluated with respect to actual indoor air site data. It is recommended that this information be obtained through implementation of an indoor air monitoring program and collection of soil samples/subsurface air samples from directly beneath and in close proximity around existing site buildings. Review of actual site data could then be used to make assessments related to indoor air considerations. A

"No Action" alternative would not provide a means to assess or address an indoor inhalation risk.

It is likely that in any remedial alternative, efforts to preserve existing buildings on the PGC property would be made. This would result in leaving contaminated soils in place beneath existing buildings. In such a scenario, it is assumed that a long-term indoor air monitoring program would be necessary to monitor any future potential for exposure from this route.

5.3.2 Area Infrastructure Work - ROWs

It is feasible that area infrastructure work could result in direct contact exposure with both soil and groundwater. Depending on the degree of intrusive work within street ROWs, it is plausible that utility workers could become exposed through direct contact with the coal tar waste. Likely infrastructure activities could involve drainage ditch work along the south side of the PGC property; telephone, sewer, water, and/or natural gas underground utility work in the vicinity of the culvert that crosses M-26. Refer to Figure 2 for review of utility locations. Roadwork could also result in utility worker exposure to contaminated materials if the need for excavation would occur.

Under a "No Action" alternative the risk of exposure from direct contact to utility and road workers would not be diminished. Institutional controls, engineering controls and/or removal efforts would be needed to protect against exposure.

5.3.3 Residential Land Usage

The degree and extent of contamination on residential and within wetland areas is much less than has been reported on the PGC property. These areas are largely vegetated and unless there are residential type intrusive activities, direct contact is considered limited. It should be noted that the contaminated shallow fill has also been placed in these areas. It is possible that the reported contamination in the residential and wetland areas is due to historical backfilling activities and/or other area influences.

A "No Action" alternative would not provide for any residential land use restriction.

5.3.4 Surface and Storm Water Runoff

Human exposure through contact with surface water is plausible but considered to be minimal. At present the undisturbed water in the ditch does not appear to be adversely affected by the coal tar wastes. However, exposure would be possible if contaminated media along the northern edge of the drainage ditch adjacent to Franklin Street were disturbed or if there was subsurface infrastructure work in the vicinity of the M-26 culvert.

Exposure to contaminated storm water runoff especially in ponding areas on the PGC property is also plausible, since soil contamination is present on the property at shallow depths. No information has been collected to date to determine if exposure to storm water run-off on the PGC property poses a threat. Since surface water in the area does not appear to be adversely affected, it is possible that the risk may be minimal.

A "No Action" alternative would not protect against potential human exposure risk due to contaminated surface water. A combination of institutional controls, engineering controls and removal efforts reduce exposure caused through contact with contaminated surface and storm water run-off.

5.3.5 Water Usage

The bedrock aquifer has been identified as the primary source of potable groundwater usage in the area. At this time it does not appear that use of existing area potable drinking water wells will result in human exposure.

A "No Action" alternative would not protect against any future intentions to use this groundwater source and would result in a possible exposure risk. Institutional controls (deed restrictions) in the form of land and groundwater use restrictions could protect against future exposure. Limited removal and engineering controls in areas of significant contamination would further reduce the threat of potential further migration, although with significantly greater implementation considerations. Large-scale extraction and treatment of groundwater is not considered to be necessary, given the apparently slow groundwater contaminant migration potential. Engineering controls focusing on overall reduction of soil contamination would likely result in an overall improvement to shallow groundwater quality. Contamination remaining beneath buildings potentially exceed industrial direct contact and indoor air inhalation criteria and would require further consideration.

5.3.6 Remedial Construction

Human exposure through direct contact and inhalation during active remediation activities is plausible. Workers conducting active remediation would require health, safety, and protection measures under the current OSHA HAZWOPER Regulations 29 CFR 1910.120. Remedial activities that include removal will be more involved. Engineering controls for equipment and construction operations to minimize exposure would also be required.

5.4 ECOSYSTEM

There are many studies that have reported on the effects of various constituents of **MGP by-products** including those present in coal tar waste **(VOCs, SVOCs, metals, ammonia**, etc). **It appears that there may be both** acute **and chronic effects including bioaccumulation and long-term exposure scenarios that could lead to carcinogenic effects** (ERT 1984). Much of the potential exposure is directly related to the bioavailability of the contamination for ecological exposure. **Ecological receptors of concern in the adjacent and down gradient wetland environment include the following general groups: benthos, fish, zooplankton, phytoplankton, birds, amphibians, and mammals.**

Under the NREPA, the Part 201 GSIP criteria for soil and groundwater, and Rule 57 FCV values for surface water quantify generic levels of acceptable exposure without adverse affects to the ecosystem. The GSIP acceptable soil concentrations and GSI acceptable groundwater criteria are derived from a comparison of the chemical specific Human Non-Drinking Water Value (HNDV), the Wildlife Value (WV), and the Final Chronic Value (FCV). Of these, the FCV is often the most restrictive value and is based on indicator organism (ecological) exposure limits, making GSI criteria relevant to the ecosystem. The Rule 57 FCV value for surface water is similar to the FCV value in the GSI algorithms.

Soil GSIP and groundwater GSI criteria exceedances are present for VOCs, SVOCs, metals, and ammonia at the Plant Site. **[illegible] criteria exceedances present indicate that there is potential ecological risk at the Plant** Site. Although the level of ecological risk that would remain under a given alternative is difficult to quantify, **implementation of an alternative that actively addresses source removal in the short-term would likely result in a greater reduction of risk than those that would leave contamination in place.**

At the Plant Site, the main focus of ecological concern is the minimally contaminated upgradient wetland north of the Plant Site. Contamination in the upgradient wetland is not likely to migrate much further north in this area given the hydrogeologic flow conditions to the southeast. However, **[illegible] the drainage ditch serves as the conveyance, there is a chance that some additional migration along the drainage ditch could occur.**

In order to better understand the site-specific ecological risk at the site, a baseline ecological risk assessment using a weight-of-evidence approach could be completed to assess site-specific ecological risks. This would allow for a comparison of the risks present as they relate to various contaminant concentrations across the site. Estimated costs to complete a weight-of-evidence ecological risk assessment is approximately $75,000. It has been assumed that the focus of the assessment would mainly be on the downgradient upper and lower wetlands. An element of the assessment would also focus on the Plant Site. Costs for this assessment have been considered in the "*Remedial Feasibility Study Report, Upper and Lower Wetlands, Florida Gas Site, Florida Location, Michigan, January 2001*". Information from the assessment would be used to determine the extent to which impacts on the wetland upgradient of the Plant Site area should be considered.

It is unlikely that any alternative would immediately remove all ecological risk in the short term. The acceptability of the long-term ecological risk from the amount of contamination left in place in a given alternative is part of the decision making process.

Short-term ecological risks to the environment must also be considered. Active remediation activities would allow for potential contamination introduction into the surface water environment during removal. Although measures would be taken to minimize release of contaminants into surface waters and the ecosystem, it is likely that some short-term deterioration would occur.

6.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

Conclusions of the RI and the preliminary risk assessment provide the basis for the formulation of a site conceptual model and applicable remedial objectives. The remedial alternative development process consists of a series of analytical steps that involve making successively more specific definitions of potential remedial activities. A description of the site conceptual model, remedial action objectives, and the defining process (through the identification of potential remedial alternatives) is provided below.

6.1 SITE CONCEPTUAL MODEL

The contamination present at the site is primarily due to the presence of **coal tar waste.** However, **oil contamination** also appears to be present. The contaminants present include VOCs, SVOCs, metals, and ammonia.

The identified applicable NREPA Part 201 soil clean-up criteria used in the evaluation for the different sections are as follows:

Sections 1-7 (Main Focus –Industrial)

- Industrial/Commercial II Direct Contact Criteria
- Groundwater/Surface Water Interface Protection Criteria
- Industrial/Commercial II, III, and IV Soil Volatilization to Indoor Air Inhalation Criteria
- With consideration to residential criteria

Sections 8-11

- Residential/Commercial I Drinking Water Protection Criteria
- Groundwater/Surface Water Interface Protection Criteria
- Residential/Commercial I Direct Contact Criteria
- Residential/Commercial I Soil Volatilization to Indoor Air Inhalation Criteria

The identified applicable NREPA Part 201 groundwater clean-up criteria for the different sections are as follows:

Sections 1-7 (Main Focus –Industrial)

- Industrial/Commercial II, III, and IV Drinking Water Criteria
- Groundwater/Surface Water Interface Criteria
- Industrial/Commercial II, III, and IV Groundwater Volatilization to Indoor Air Inhalation Criteria
- With consideration to residential criteria

Sections 8-11

- Residential/Commercial I Drinking Water Criteria
- Groundwater/Surface Water Interface Criteria
- Groundwater Contact Criteria
- Residential/Commercial I Groundwater Volatilization to Indoor Air Inhalation Criteria

In general, the estimated extent of highly contaminated material is limited mainly to the soils contaminated with coal tar waste or oil located on the PGC property and within the drainage ditch as denoted by the dark shading on Figures 3A and 3C. Sections 1 and 2 on the PGC property may also be highly contaminated, but due to sampling difficulties and the parameters not analyzed in historical data, the actual degree of contamination is not known at this time. Confirmation remedial alternative verification sampling (RAV) to further assess concentrations in Sections 1 and 2 should be performed prior to implementation of a remedial action. The RAV sample analytical results would be utilized to verify the feasibility of the chosen remedial alternative in Sections 1 and 2.

The highly contaminated soils serve as the source of groundwater and potential surface water contamination. Groundwater collected from monitoring wells in close proximity to the highly contaminated soils exhibit some contamination, although minimal by comparison to contaminated soils. Groundwater contamination also appears to be mainly limited to the upper unconfined aquifer (the fill, peat, sand/gravel unit, and upper portion of the calcareous glacial till) with minimal VOC or SVOC contamination. The deeper calcareous glacial till present is likely functioning as a confining layer, based on calculations for hydraulic conductivity ranging between $1x10^{-5}$ and $1x10^{-7}$cm/sec. VOC and/or SVOC contamination is minimal and naturally attenuates, beyond the limits of the highly contaminated soil areas.

Where the organic peat layer has been removed, downward migration of contaminants into the lower lying sandy soils may have occurred, i.e., the old tar storage tank, former building or tank foundations, that are included in the highly contaminated soils area.

Where soil contamination is present beyond the highly contaminated soils, it appears to be related mainly to shallow fill, not necessarily related to the practices at the former MGP as depicted by the light shaded areas on Figures 3A and 3C. In many instances the fill consists of gravel, coal, cinders and construction demolition debris that may contribute to the presence of SVOC/VOC and metals contamination. The source of the fill is unknown. Historical records show a former coal storage building on the PGC property (Sections 3 and 4), and the storage of coal may have contributed to some of the reported metals and SVOC contamination. Coal is a documented source of SVOC and metals contamination. Coal present at shallow depths in the residential areas is likely residual due to the probable historical use of coal. The presence of any ash could also be related to this use.

Because of these factors, the highly contaminated soils are viewed as the primary remedial concern.

Without any form of active source reduction it is likely that the contamination will persist in the environment with little or no significant change. This is readily attested through observations that show a large portion of the contamination still present near the original source. Given the nature of the coal tar waste and the high potential for adsorption onto the organic carbon in the soils and sediments, the slow migration of contaminants into the surrounding soils, sediments, and waters would continue to occur.

Because the current buildings will remain in place, it is assumed that some volume of contamination would remain in place in any remedial alternative chosen. The shut down, relocation, and new construction of the PGC operations have been considered impractical. It is impractical to address all of the contamination at the site through active soil capping or excavation, groundwater extraction and treatment, or surface water treatment. The cost benefit of addressing the lesser-contaminated media is lower than addressing the most highly contaminated media.

Thus, it has been assumed that a group of practical alternatives would depend on natural attenuation to some degree to address remaining contamination in order to meet Part 201 criteria. The major difference between each alternative will be the amount of aggressive source reduction that takes place and the time frame required to meet clean-up criteria.

Overall acceptability of leaving contamination in place is improved if a particular alternative reduces contaminant mass and if natural attenuation is shown to be addressing remaining contamination. The chosen alternative should be able to meet both of these criteria.

6.1.1 Human Risk Concerns

Results of the preliminary risk assessment conducted in Section 5 of the report suggests that the highly contaminated soils as shown on Figures 3A and 3B should be the main focus of remedial alternative evaluation in terms of human risk present at the site. It is possible that some highly contaminated soil extends to Sections 1 and 2 of the PGC property. Decisions regarding the degree of remediation in Sections 1 and 2 will largely depend on the results of the RAV sampling.

The greatest human risk appears to be industrial and utility worker exposure through direct contact and potential inhalation of indoor air contamination in the highly contaminated soils area. Human direct contact with groundwater is also plausible due to the presence of VOC and SVOC direct contact exceedances in groundwater.

Groundwater samples indicate these exceedances occur in the southeast portion of Section 4 and the western portion of Section 7 immediately adjacent to Section 2. Given the visual evidence of significant contamination, it is also likely that direct contact exposure considerations should be contemplated in Section 3. Much beyond the highly contaminated area groundwater does not pose a direct contact threat.

Remedial focus on groundwater is mainly in the vicinity of the highly contaminated soils as shown on Figure 12A. Source reduction in the highly contaminated soils area would likely result in a reduction in groundwater contamination. Infiltration into the highly contaminated soil area could also be limited by installation of a capping system, helping to reduce its potential affects on groundwater contamination.

Direct contact exposure could be limited through institutional controls, engineering controls, and removal efforts although each of these would result in varied levels of current and future risk exposure protection. It is likely that both an engineering control alternative such as capping, or an engineering control/removal alternative such as capping and limited removal, could provide similar protection to the industrial worker from direct contact exposure. A removal effort would mainly serve to reduce the mass of contamination, diminish groundwater migration potential, and overall future risk of exposure. A capping alternative alone would require more attention to maintain the installed remedy since more contamination would remain at the site. The importance of source reduction, groundwater migration potential, and overall future risk of exposure as compared to implementation considerations is part of the decision making process.

Implementation of an indoor air monitoring program and collection of soil samples/subsurface air samples from directly beneath and in close proximity to existing site buildings is assumed. Review of actual site data would then be used to make assessments related to indoor air considerations. In more advanced alternatives, once the risk is quantified, engineering controls and removal efforts could help to diminish or remove this potential risk.

Preserving existing buildings on the PGC property will also likely result in leaving contaminated soils in place underneath these buildings. In such a scenario, it is assumed that an indoor air monitoring program would be required to monitor any future potential for exposure from this route. Leaving the buildings in place would also provide for a certain level of future exposure risk regardless of remedial alternative. Deed restrictions on the property would also likely have to be put in place, ensuring continued indoor air exposure management through institutional and engineering controls.

Razing of buildings could potentially result in direct contact exposure scenarios in which case additional removal or capping activities would be required.

The remaining long-term human exposure scenarios (residential land usage, surface water, storm water run-off, and water usage) pose a lesser threat. A combination of institutional controls would serve to address most remaining considerations. While groundwater use restrictions would effectively reduce risk of exposure to contaminated groundwater, engineering controls would help to reduce the source of contamination.

The most likely contaminant migration pathway for groundwater is through the shallow unconfined aquifer. In a conservative approach some engineering controls to limit migration in this aquifer could be considered. However, at this time it does not appear that this aquifer is a source of drinking water resulting in human exposure. Groundwater and land use restrictions could protect against future exposure in the shallow aquifer.

6.1.2 Ecosystem Concerns

On the Plant Site, the focus of ecological concern is the wetland north of the PGC property and the drainage ditch. Contamination in the upgradient wetland is not likely to migrate much further north in this area given the hydrogeologic flow conditions, i.e., to the south. However, since the drainage ditch conveys a large amount of surface water to the down gradient wetlands, it is feasible that some additional migration of contaminants could occur.

The overall toxicity and long-term effects of the contamination on the ecosystem is not known and a site specific baseline ecological risk assessment could be considered for the FG Site.

Short-term ecological risks to the environment would be a consideration for active remediation activities. Active remediation could result in the potential release of contamination into the surface water environment. Although measures would be taken to minimize release of contaminants into surface waters and the ecosystem, it is likely that some short-term deterioration would occur.

6.1.3 Contaminant Mass Location

A preferred alternative will most likely be one that best addresses overall contamination at the site. Based on the information collected to date, a significant portion of the known contamination can be addressed by focusing on the highly contaminated soil source area shown on Figures 3A and 3C.

Studies conducted for the Utility Solid Waste Activities Group Superfund Committee completed by Environmental Research and Technology, Inc. in 1984 indicate that MGP coal tar's major constituents (90 percent to 95 percent) are light to heavy oils and carbon (ERT1984). Most of the oils are heavy and contain SVOCs while the lighter oils contain VOCs. Coal tar waste is therefore expected to contain large quantities of SVOCs and VOCs.

Since coal tar waste is made up of mainly SVOCs and VOCs, it is reasonable to assume that if the majority of the SVOC/VOC contamination at a site is delineated, then the greatest contamination mass has been identified. Most of the VOC/SVOC, coal tar, or oily contaminated soils appear to be located on the PGC property and in the unexcavated portions of the drainage ditch. The remaining soils with contamination present have limited to no VOC/SVOC, "coal tar", or "oily" contamination present. Thus, by removing the accessible highly contaminated soil area shown on Figures 3A and 3C, which has the highest known SVOC and VOC concentrations and visual contamination, a large reduction in contaminant mass would be achieved.

The portions of the Plant Site (see Figure 2) most affected by soil contamination are Sections 3 and 4 on the PGC property and the Drainage Ditch/Franklin Street ROW (Section 5). The Street ROW North of the PGC property (Section 7) is also affected although to a lesser degree.

6.1.4 Natural Attenuation

There is some indication that natural attenuation is presently occurring at the Plant Site because much beyond the extent of the highly contaminated soil, contaminant concentrations decrease. However, given the amount of contamination it is likely that the natural attenuation process will continue to be very slow. Hence, the amount of time required by natural attenuation to meet clean-up criteria is dependent on the overall concentration of contamination remaining at a particular location. The acceptability of the time frame is part of the decision-making process.

The natural attenuation processes involved are physical, chemical, and biological in nature, and include dispersion, dilution, volatilization, sorption, and biodegradation. Given the nature and extent of contamination, it is unlikely that any active remedial alternative will achieve Part 201 criteria immediately after the construction period ends. However, an alternative using natural attenuation to address contamination left in place would still be consistent with Part 201 in that each alternative would provide a means to attain compliance with the Part 201 soil/groundwater criteria. Those alternatives in which reduce contaminant mass through aggressive removal would likely be preferred, as the amount of time needed to meet clean-up criteria would also be decreased. It would be necessary to further evaluate the feasibility of addressing the remaining SVOCs, VOCs, and metals contamination through natural attenuation. Removal of ammonia through natural attenuation is both less likely because it is naturally occurring in a wetland.

6.1.4.1 Feasibility of SVOC/VOC Natural Attenuation

Some SVOCs and VOCs would be left in place even under an active removal option. Of the natural attenuation processes, only biodegradation has the potential to permanently remove VOC and SVOC contamination from the environment. Biodegradation of SVOCs and some VOCs has been known to occur in anaerobic denitrifying conditions (Mihelcic 1988). Most of the organic contamination is made up of SVOCs, therefore, they are the main biodegradation consideration. In many instances the rate of degradation for SVOCs is actually faster under anaerobic conditions than under aerobic conditions. The rate of degradation often depends on the concentration of contaminant not being so high as to be toxic to the micro-organisms, to some degree the availability of the contaminant, and the presence of an appropriate geochemical environment. Micro-organisms are also known to adapt to use SVOCs in their metabolism processes (Mihelcic 1988).

Present conditions indicate that the site is primarily anaerobic. This suggests that the present environment is appropriate for SVOC degradation. Given these anaerobic denitrifying conditions at the site, biodegradation of the VOCs/SVOCs will likely still occur at a slow rate of decay (Mihelcic 1988). Hence use of natural attenuation will result in a longer time frame to meet Part 201 contaminant clean-up criteria. The trade off between removal practicality and time frame acceptability for natural attenuation to address remaining contamination is part of the decision making process.

6.1.4.2 Feasibility of Metals Natural Attenuation

Metals are not attenuated through biodegradation. In many instances the most effective treatment options are chemical. Chemical treatments bind or precipitate metals making them unavailable for uptake, thereby reducing metals toxicity. Due to the ionic nature of metals, removal through groundwater extraction is considered impractical. A preferred removal mechanism is basic ionic attraction forces that cause metals to bind to a soil substrate or precipitation of inorganic non-toxic metals compounds.

There is an organic peat layer that is present on portions of the site that would help to immobilize metals. Metals mobility is limited under the anaerobic groundwater conditions tending to reduce their solubility. The presence of carbonates in the calcareous till may help form some metals precipitates.

Metals migration potential is mainly limited to groundwater in the shallow unconfined aquifer above the calcareous glacial till. Migration of metals contamination through this till is unlikely. The shallow unconfined aquifer is currently not being used as a source of potable water, hence the potential human exposure risk is minimal. The ecological risk present from metals in groundwater will continue to diminish as natural attenuation occurs.

6.1.5 Additional Considerations

Review of historical data collected at the site suggests that most of the historical underground features such as underground tanks, building foundations, and above ground tank footings likely remain (Appendices A-1 through A-3). Evidence collected during field activities suggests that this may include a 100,000 cubic foot gas holder footing in the southwest corner of the PGC property, an underground tar tank in the middle of the PGC property, a 35,000 cubic foot gas holder footing in the eastern corner of the PGC property and several building foundations that were present along the western edge of the PGC property. Additional buildings or structures not confirmed in the field include the former coal shed, an 8,000 gallon crude oil tank, two (2) oil storage tanks, and various other out-buildings. Historical records also show a former building which appears to have been a supply warehouse located near the railroad tracks to the north in Section 8. The presence of these structures may require special consideration for any remedial alternative.

Consideration of surface water run-off in conducting a remedial action is required. A large amount of water enters the site and will require attention.

The number of utilities, the active propane distribution, and the current use of buildings in or near highly contaminated areas will present additional engineering concerns. It is assumed that the current buildings will remain in place. Given the hazards of working near propane storage areas, thermal or electrically based in-situ treatment methods were not considered. It is also assumed that contamination is present beneath existing buildings.

Short-term human exposure risk would mainly include workers conducting active remediation and would require health, safety, and protection measures under the current OSHA HAZWOPER Regulations 29 CFR 1910.120. Remedial activities that include removal will be more involved. Engineering controls for equipment and construction operations to minimize exposure would also be required.

It is assumed the contaminated soils are not considered to be a "characteristic" hazardous waste. The hazardous waste characterization assumption has been made on the basis of USEPA's and CEC's Toxicity Characteristics Leaching Procedure, reactivity, corrosivity and ignitability analyses.

6.2 REMEDIAL ACTION OBJECTIVES

Upon completion of the site conceptual model, site-specific remedial action objectives were defined for the project site. Remedial objectives were split into primary and secondary considerations.

Primary Considerations:

- Minimize potential risk to human health, aquatic and terrestrial animals, plants and the environment from exposure to contaminants, focusing on direct contact.

- Limit migration of contaminants to the extent practicable.

- Minimize long-term negative disturbances/impacts to the nearby wetland environment.

- Maximize reduction of contaminant mass and concentration.

- Minimize short-term risk to human health and the environment from exposure during the implementation of the remedial action.

Secondary Considerations:

- Minimize the length of time required to meet general clean-up criteria.
- Minimize long-term expenditures, maintenance, and upkeep.
- Minimize risk of future liability.
- Control remediation capital expenditures.

6.3 GENERAL RESPONSE ACTIONS

General response actions were identified to describe those actions that will satisfy the remedial action objectives. Project specific general response actions for each media of concern (highly contaminated soils and groundwater) are presented on Table 1 and discussed below.

6.3.1 Highly Contaminated Soils

Eight (8) general response actions were identified for the highly contaminated soils area. They include: no action, institutional controls, monitoring/natural attenuation, containment, surface stabilization, in-situ control/treatment, limited removal/off-site treatment, limited removal/on-site treatment.

Most of the general response actions are self-explanatory. Limited removal focuses only on the most highly contaminated areas on the Plant Site with the majority of the VOC and SVOC contamination while leaving the existing structures in place. Full removal would require razing of most, if not all of the structures on the PGC property, and was not considered.

6.3.2 Groundwater

Groundwater general response actions include no action, groundwater use restrictions, monitoring/natural attenuation, gradient controls, extraction and treatment, and in-situ treatment.

6.4 IDENTIFICATION OF TECHNOLOGY TYPES AND PROCESS OPTIONS

General response actions for each media were further categorized through the identification of potentially applicable remedial technologies and process options, as shown on Table 1. A short description is provided on the table for each set of general response actions, remedial technologies, and process options identified.

"Remedial technologies" refers to general categories of technologies such as biological treatment, chemical treatment, physical treatment, and capping. "Process options" within each technology type were also reviewed. For example, the in-situ treatment, physical treatment technology type for soil includes such processes as soil aeration, soil vapor extraction, fixation, and solvent extraction.

The applicability of the collected general response actions with the associated remedial technologies and process options were then reviewed based on applicability to meet site remedial objectives. Viable options were carried forward for assessment based on effectiveness, implementability, and cost.

6.5 SCREENING TECHNOLOGY TYPES AND PROCESS OPTIONS

In this step, the potentially applicable technology types and process options identified in Section 6.3 were reduced through evaluation of each set based on effectiveness, implementability, and cost. Each set was evaluated with a short explanation of the determination for each set provided on Table 2. Viable sets were carried forward and combined into specific remedial alternatives for more detailed evaluation. In depth evaluation did not take place at this level, as this tool was used to identify options that did not merit additional consideration. A description of effective implementability and cost considerations is provided below.

Effectiveness includes both long-term and short-term considerations. This included a qualitative evaluation of the degree to which a remedial alternative will protect public health, safety, and welfare over time, including disposal considerations and evaluation of any adverse impact expected on public health, safety and welfare, and the environment that may be posed during construction, implementation and closure.

The implementability of each general response action, remedial technology and process option was evaluated. The consideration included engineering, construction, permitting, and long-term maintenance along with effectiveness monitoring and overall difficulty.

Cost was evaluated as either none, low, moderate, or high in terms of capital and long-term costs.

7.0 DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES

Based on the retained general response actions, remedial technologies, and process options, five (5) remedial alternatives were assembled for further evaluation as shown on Table 3.

The potential remedial alternatives for addressing highly contaminated media have been retained for further analysis. The potential remedial alternatives fall primarily into one or more of the following categories:

- No Action.
- Institutional Controls – Deed restrictions, use restrictions, and fencing to prevent exposure to contaminants.
- Natural Attenuation – Contaminant reduction by naturally occurring chemical/physical processes and naturally occurring biological organisms.
- Engineered Controls – Capping to prevent exposure to contaminants or reduce leaching of contaminants.
- Limited Source Removal – Excavation of coal tar wastes and the most highly contaminated media to prevent exposure to contamination and reduce the contaminant mass and the potential migration of contaminants.

The potential remedial alternatives for addressing the groundwater media that have been retained for further analysis fall primarily into one or more of the following categories:

- No Action.
- Institutional Controls – Groundwater use deed restriction.
- Natural Attenuation – Contaminant reduction by naturally occurring chemical/physical processes and naturally occurring biological organisms.
- In-Situ Treatment – Groundwater migration control and contaminant reduction in groundwater and saturated soils through the implementation of a biological treatment system designed to introduce oxygen and possible nutrient enhancement to aerobically degrade contaminants.

8.0 DETAILED ANALYSIS OF ALTERNATIVES

Remedial alternatives were evaluated in accordance with accepted analysis criteria to provide both positive and limiting rationale to implement a particular remedial alternative. The comparison process in turn provided relevant information to allow for the selection of an appropriate response action.

The analysis of alternatives was preformed on the basis of the site conceptual model presented in Section 6.1 and the following additional understandings:

- The degree and extent of contaminated soils and groundwater media have been adequately defined for the purpose of evaluating remedial alternatives.
- **Contaminated soils and groundwater are considered non-hazardous for disposal purposes as determined by the waste characterization sampling performed during the RI.**
- Surface and groundwater removed during remedial activities can, at a minimum, be treated at a municipal sanitary wastewater treatment plant.
- Limited removal of contaminated soils will focus on the dark shaded areas of soil contamination as shown on Figures 3A and 3C.
- The coal tar wastes that are proximate to the M-26 culvert have a potential for contributing to groundwater contaminant migration. Given the number of utilities in this area, there is also a potential for utility worker exposure.
- Removal of underground foundations, concrete, etc. will be required in more aggressive alternatives, and will likely complicate work. It is **assumed that the historical underground tar tank as shown in Appendix A-2 will be included in any removal activities, this also requiring the removal of the small truck scale building.** The rest of the existing structures, the Propane ASTs, the Maintenance Building and the Propane Air Mix Plant will remain in place. Foundation removal work will also include the old retort building, three (3) oil storage tank footings, and two (2) gasometer footings.

- The function of the PGC property as an operating utility company will require consideration to assure that the utility can continue to provide services to the community during the implementation of any remedial alternative. More intrusive remedial alternatives will require greater efforts to meet this goal.
- If a limited removal approach is considered, RAV sampling would occur in Sections 1 and 2 of the Plant Site to determine if there is any additional area within these sections warranting inclusion in removal activities. Based on information collected to date in this area, there is information to suggest at least some portion of these sections would be included, therefore an additional amount of contaminated soil is also included in the soil disposal tonnage estimate. A RAV sampling plan would include initial soil borings to determine locations prior to active excavation activities and confirmation test pitting with a backhoe during the excavation mobilization of equipment.
- Any remedial alternative, besides no action, is assumed to require the implementation of an air monitoring and maintenance program to protect the health and safety of PGC property workers from the likely threat of inhalation of contaminated indoor air.
- An environmental monitoring program is also assumed including monitoring of possible contamination in soil, groundwater, surface water, and run-off water as necessary to identify areas of concern in the future to address possible changes in site conditions.
- **Readily accessible highly contaminated** soils depicted in Figure 3 **are assumed** to **extend to a depth of approximately 6 to 8 feet** BGS **in some of the filled areas of the Plant Site. In the northeast-unfilled** corner of the PGC **property, depth** of **contamination is likely less, estimated to a depth of approximately** 5 **feet.**
- **Approximately 14,800 tons of highly contaminated soil and coal tar waste would be excavated during a limited removal.** Further adjustments may be necessary based on water content and preparation for shipping or thermal treatment requirements.
- Implementation of an engineered system to collect or treat contaminated groundwater will require initial pilot testing to determine site-specific design parameters. It is assumed based on the available information that the specified alternative would be

readily implementable. Any groundwater remediation system will focus on the groundwater present in the sand layer beneath the peat layer and above the calcareous glacial till to an approximate depth of 20 to 25 feet.

- If there is a need to install a remediation building it has been assumed that it would be located in Section 4 to the east of the southeast edge of the Maintenance Building.
- In a capping alternative, the area of the impermeable cap would extend to or slightly beyond the extents of the highly contaminated soil area shown on Figures 3A and 3C. This area includes the street ROW north of the PGC property and would be the northern boundary of the cap. The western boundary of the impermeable cap would extend to Highway M-26. The southern boundary would extend to the northern edge of the excavated drainage ditch. The total estimated area of the asphalt cap is approximately 7,000 square yards.
- A cap system on the PGC property must be capable of handling truck traffic. The cap is assumed to require 4 inches of asphalt, 8 inches of aggregate base, and 12 inches of granular fill. A truck off-loading pad near the Propane ASTs would also be installed. It is also assumed that undercut to a depth of 2 feet along with site grading would be required. This would also result in a volume of contaminated soil and a volume of non-contaminated soil that would require transportation and disposal. In a capping only alternative, the quantity of contaminated soil disposal is estimated to be 5,300 tons. It is also assumed that a certain amount of handwork would be required around the existing Propane ASTs to install an impermeable cap.
- A culvert would also be installed through the northern railroad grade to control ponding of large amounts of surface water to the west of the railroad grade immediately upgradient of the Plant Site.
- It is assumed that most of the existing structures on the Plant Site are to remain in place even during a limited source removal. Cost estimates have been structured on this assumption. Assessment and required monitoring caused from the risk present by leaving these structures in place is also evaluated. Structural changes are not accounted for and would likely increase estimated costs.

In considering the remedial alternatives, the primary objectives are to protect public health, safety and welfare, minimize disturbances to the natural environment, and reduce the contaminant mass. The evaluation of possible remedial alternatives was also completed with an understanding that there would be a need to implement a NREPA Part 201 remedial action plan. Site-specific remedial action objectives are presented in Section 6.2.

The administrative actions necessary to implement a particular remedial alternative will require special approaches in order to achieve these goals. This may include obtaining access agreements from affected property owners to allow remedial work to be completed on their property, formal approvals to disturb wetland and drainage areas, and placement of deed restrictions to limit future land/groundwater use. It has been assumed that access to private property will be granted, all local/state/federal approvals can be obtained and any deed restrictions will be provided.

Administrative expenses have been included as a component of capital costs and should be viewed as a budget allocation. Due to the wide range of variability in administrative activities, estimated administrative costs carry a high degree of uncertainty and therefore, need to be modified and refined on a continual basis.

The long-term liability to owners of property that has been effected by the contamination will also likely need to be a part of the evaluation process. These considerations could have an effect on the selection of a remedial action but are beyond the scope of the remedial alternative analysis.

The detailed analysis of alternatives includes the following:

- Further definition of each alternative.
- Compliance with environmental regulations.
- Permits and approvals.
- Present worth cost analysis.
- Comparison of remedial action against evaluation criteria.

8.1 ANALYSIS CRITERIA

In accordance with the referenced USEPA guidance, the evaluation criteria encompass regulatory compliance, technical feasibility, cost, and acceptability. Each criterion is briefly described below.

8.1.1 Regulatory Compliance

In the evaluation of regulatory compliance, the alternative as a whole is evaluated with respect to its ability to achieve and maintain protection of human health and the environment.

8.1.2 Technical Feasibility

Technical feasibility is evaluated against four (4) criteria: long-term effectiveness, short-term effectiveness, implementability, and restoration timeframe. Considerations under each of these criteria are provided below.

8.1.2.1 Long-Term Effectiveness

Long-term effectiveness is the degree of reduction in the toxicity, mobility, and mass of the contaminants that can be expected in the long-term. This criterion also considers the degree to which a remedial alternative will protect public health, safety and welfare and the environment over time.

Long-term impacts are considered for the site as well as for any wastes that are disposed of off-site.

8.1.2.2 Short-Term Effectiveness

The short-term effectiveness of a remedial alternative takes into account any adverse impact on public health, safety and welfare and the environment that may be posed during construction and implementation. This may include noise, odor, and traffic impacts created by removal or treatment of contaminants or installation of remedial systems, short-term ecological risk, and health and safety construction issues.

8.1.2.3 Implementability

This criterion measures how well a remedial alternative can be implemented. This factor evaluates all of the following:

- The technical feasibility of construction and implementing the remedial action option at the site or facility.
- The availability of materials, equipment, technologies and services needed to conduct the remedial action option.
- The potential difficulties and constraints associated with on-site construction or off-site disposal and treatment.
- The difficulties associated with monitoring the effectiveness of the remedial alternative.
- The administrative feasibility of the remedial alternative, including activities and time needed to obtain any necessary licenses, permits, deed restrictions or approvals.
- The ecological impacts.

- The technical feasibility or operation and maintenance.
- The feasibility of natural attenuation.

8.1.2.4 Restoration Timeframe

This criterion considers the expected timeframe needed to achieve the necessary restoration, taking into account all of the following qualitative criteria:

- Proximity of contamination to receptors.
- Presence of sensitive receptors.
- Presence of ecological receptors.
- Current and potential use of the aquifer, including proximity to private and public water supplies.
- Magnitude, mobility and toxicity of the contamination.
- Geologic and hydrogeologic conditions.
- Effectiveness, reliability and enforceability of institutional controls.
- Natural attenuation.

8.1.3 Economic Feasibility

Economic feasibility is evaluated against four (4) criteria: capital costs, annual operation and maintenance costs, present worth, and future liability. Considerations under each of these criteria are provided below.

- Capital costs are those expenditures for construction of the remedial action including labor, equipment, materials, land, disposal costs, professional services, and administrative expenses

- Annual operation and maintenance costs represent those expenses that recur over time including operation, maintenance, environmental monitoring and any other long-term cost.
- Present worth analysis evaluates the effect of expenditures over different restoration timeframes by discounting all future costs to a common base year.
- Future liability potential is evaluated on the basis of remaining exposures.

8.1.4 Acceptability

Two (2) other criteria are also important in the process of selecting the appropriate remedial action. They include MDEQ acceptance and community acceptance. Issues and concerns the MDEQ or community may have regarding each alternative are usually evaluated after completion of the FS.

8.2 ALTERNATIVE 1 – NO ACTION

8.2.1 Description of the Remedial Alternative

This alternative would provide no action to address the contaminated soils identified to be present and the contaminated groundwater media. Under this remedial alternative, no future efforts would be expended to remediate or monitor the highly contaminated soil or the contaminated groundwater media. Reduction in contaminant mass would rely entirely on natural attenuation without monitoring.

8.2.2 Considerations of the Remedial Alternative

Alternative 1 would be the easiest to implement, as it would require no remedial response, environmental monitoring, or institutional controls. However, it may not be acceptable since no further action would be made to protect the health, safety and welfare of the public or PGC work force nor would any efforts be made to improve the environment. Direct contact exposure pathways to humans and ecological effects within the surrounding environment of the contaminated soils would remain and the contaminated groundwater media would not be controlled.

Because contamination exceeding applicable clean-up criteria is present, an approvable plan to address the environmental impacts is required. A No Action alternative would not fulfill this requirement.

Permits, access agreements and approvals from the MDOT for work in the ROW of State Highway M-26, from the HCRC for work within the ROW of Franklin Street and the access road on the north side of the Plant Site, and for work on private property would not be required. Property deed restrictions would not be necessary to limit land and groundwater uses. Also, notifications to utility companies would not be made to advise them of the presence of contaminated soil and groundwater, the need to obtain access authorization, or the need for safety controls and a contaminated materials management program when performing subsurface work.

The timeframe for restoration of the contaminated soil and groundwater media would be long. The only process under this alternative that could reduce contaminants would be natural attenuation. The time period for natural attenuation without any source reduction is likely to be far longer than the time that has already elapsed since the coal tar wastes have been deposited on the Plant Site. The estimated time frame for natural attenuation to take place under this option is greater than 75 years. It is probable that natural attenuation alone would not provide for restoration of the Plant Site.

There would be no short-term impacts other than what may occur at present because no further work would be completed in the Plant Site. Long-term impacts would persist as the mass and toxicity of contaminants would not be reduced. In addition, no efforts would be made to control the mobility of the contaminants.

The present worth cost for this remedial alternative is zero because no remedial work or environmental monitoring would be performed. Neither capital cost expenditures or annual operation and maintenance would be required. Expenses for monitoring the groundwater, area surface water, air quality in on-site buildings, on-site storm water or the contaminated soil would not be needed. Also, costs for institutional controls to limit land and groundwater uses or access to the Plant Site would not be necessary.

The future liability associated with implementing a no action alternative is the highest of all the potential alternatives. Exposure pathways would remain uncontrolled. No reduction in contamination, toxicity, contaminant mass, or mobility would occur.

8.3 ALTERNATIVE 2 – INSTITUTIONAL CONTROLS

8.3.1 Description of the Remedial Alternative

In this alternative institutional control measures would be implemented to impose certain land and groundwater use restrictions. The land and groundwater use restrictions would be imposed on the Plant Site in order to protect the health, safety, and welfare of the public and PGC work force by means of reducing the potential of direct contact with the contaminated soil and groundwater. This alternative would also provide the means to understand the potential risk of exposure to inhalation of contaminated indoor air. Like Alternative 1, this alternative would not include any significant remedial response activity in terms of capping, removal of contaminated materials, or active indoor air control systems. Reduction in contaminant mass would rely entirely on natural attenuation.

Deed restrictions would be placed on property and/or developed through governmental agencies. The restrictions would require that if any land or groundwater use changes were planned, it could not proceed without an MDEQ approved plan. The purpose of the land use restriction would be to prevent any use of the Plant Site that would result in disturbing contaminated soil. Restrictions would also be established that would prevent the use of the groundwater aquifer(s) within and around the entire FG Site.

Physical access restrictions would be accomplished by constructing a new fence around the perimeter of the PGC property and placing signs on the fence to warn that hazards are present. The fence would have three (3) strands of barbwire and five (5) large gates to accommodate PGC truck traffic. Perpetual fence maintenance would be required.

Notification to utility companies regarding the presence of contaminated materials and access restrictions would need to be performed. Safety controls and a contaminated materials management program would be necessary when and if utility subsurface work occurs.

Environmental monitoring in and around the Plant Site would be done to determine if changes are taking place in the contaminated soils and groundwater media with regards to contaminant concentration, mobility, and natural attenuation. The program would also include monitoring of surface waters around the Plant Site. A detailed environmental monitoring plan for groundwater monitoring, surface water monitoring, and contaminated soil monitoring would be prepared prior to initiating this alternative.

Under the groundwater monitoring program, the twenty-five (25) existing monitoring wells would be sampled. In addition, six (6) new monitoring wells would be constructed and two (2) soil samples would be obtained from each well location at the time of installation. The amount of groundwater monitoring would vary with time. Initially for a 2-year period, all existing wells would be sampled on a quarterly basis. After that, sampling would be semi-annually for 3 years and then annually thereafter with an alternating season frequency (i.e. spring, summer, fall and winter). All thirty-one (31) wells would be sampled in each monitoring event. The samples would be sent to a state-approved laboratory and analyzed for analytical parameters similar to those completed during the Plant Site RI. The analytical regime would include VOC, SVOC, metals, ammonia, nitrate, sulfate, sulfide, and cyanide. Field parameters to assist in assessing natural attenuation would also be included and would at a minimum include pH, conductivity, dissolved oxygen, reduction/oxidation potential, and dissolved iron.

The surface water monitoring program would include sampling at three (3) locations. Two (2) locations would be from the existing drainage ditch along Franklin Street from the east end of the Plant Site to the intersection of Franklin and Houghton Streets. The other surface water sampling location would be in the wetland area north of the Plant

Site. The frequency and analysis will be the same for the surface water and groundwater samples.

Monitoring of the highly contaminated soils throughout the Plant Site would consist of collecting samples to evaluate any possible changes that may be occurring. Sampling would be performed at ten (10) locations within the Plant Site. Soil samples would be collected on a 10-year frequency. The analytical laboratory analysis regime would be the same as that planned for the groundwater samples.

To understand the potential for exposure to air contamination, an indoor air monitoring program would also occur as part of the overall environmental monitoring program associated with this alternative. The air quality in and around the three (3) existing buildings on the Plant Site would be monitored to assess the potential risk for PGC workers of exposure to inhalation of contaminated air. The monitoring would be specific to potential impacts from contaminated soil and not for monitoring the current business operations of PGC. A detailed indoor air monitoring plan (IAMP) for the Plant Site would be prepared prior to initiating this alternative. This IAMP would not be prepared to satisfy any governing laws or regulations for which PGC would be responsible to comply with as it pertains to air quality associated with their current business operations and facility management practices on the Plant Site. An inspection of the buildings would also be made to determine general maintenance that would need to be performed to reduce the potential for exposure to air contamination.

In order to implement the IAMP, indoor air monitoring probes would be installed. Six (6) probes would be placed inside the buildings and ten (10) probes would be placed along the exterior perimeter of the buildings. During installation of the probes, soil samples will be obtained to allow for evaluation of possible contaminated soil conditions under the building floors and immediately surrounding the buildings. The laboratory analytical analysis regime for the soil samples obtained during installation of the indoor air monitoring probes would be the same as that planned for the groundwater samples. Once the probes are in-place, air quality sampling would begin and be collected on a monthly frequency for the first year and then on the same frequency as the groundwater samples. The analytical laboratory analysis regime for the air quality samples would be VOC and SVOC. Field sampling will be conducted at a minimum with an appropriate photoionization detector (PID) or other instruments would also occur.

A Storm Water Pollution Prevention Plan (SWPPP) would be prepared to address storm water management issues related to contaminated soils. This SWPPP would not be prepared to satisfy any governing laws or regulations for which PGC would be responsible to comply with as it pertains to storm water management associated with their current business operations and facility management practices on the Plant Site. However, this SWPPP would need to be incorporated into and made a part of the PGC SWPPP. Because of the presence of near surface contaminated soils, the existence of storm water ponding, and that fact that capping of the contaminated soils area would not be part of this alternative, collection of storm water samples would be required. Samples would be obtained from four (4) ponded areas on a frequency of four (4) times per year. The analytical laboratory analysis regime for the storm water samples would also be the same as that planned for the groundwater samples.

A review of collected data would be completed after each sampling event for all of the data collected. Reporting would be limited to the indoor air monitoring unless information from other monitoring programs would need to be brought forward.

As part of this alternative, PGC and others doing work in the Plant Site would need to obtain approval from the MDEQ for any activities within the contaminated area that would involve surface disturbances, excavation, demolition, building modification, or in general any change to the site as it presently exists. The purpose of this requirement would not only be to advise MDEQ of intended on-site alterations but also to inform MDEQ of the environmental protection methods that would need to be implemented to safeguard the public and PGC workers, and to manage contaminated soil and groundwater that may be encountered, disturbed or removed when making the improvements.

A summary of the results and findings of all environmental monitoring programs would be presented in an annual report. The report would also detail operation and maintenance work performed, present collected environmental monitoring data, identify site observations, and note areas of concerns or issues that need follow-up.

Every 5 years an evaluation of data from all environmental monitoring programs would be made to assess environmental conditions, changes in contaminant concentrations, and to consider if modifications to the monitoring plans would be appropriate.

Once the Plant Site is ready for closure, documentation of conditions observed throughout the environmental monitoring program and the conditions that exist at the time of closure would need to be prepared and submitted to MDEQ. A risk assessment of the remaining contaminated soil and groundwater as it relates to public health, welfare and safety and the ecosystem would also be required and the current closure criteria would need to be evaluated at the time of a closure request.

8.3.2 Considerations of the Remedial Alternative

Alternative 2 would be slightly more difficult to implement than Alternative 1. Alternative 2 would provide for protection of the public and PGC's workforce by limiting direct contact to contaminated media but would do nothing to improve the ecosystem. Given the shallow nature of the contamination on the Plant Site, the institutional controls implemented would be relied on heavily to provide protection to the on-site industrial workers.

This alternative could potentially comply with regulatory requirements. While this alternative would be protective of the health, safety and welfare of the public and PGC workforce, it would be less protective than other more aggressive alternatives. This is because the alternative would depend mostly on the monitoring programs implemented to identify any areas of concern. Results of any monitoring could possibly require additional engineering controls to obtain a presumed acceptable level of protection.

Implementing Alternative 2 would require engineering and administration efforts to complete the design of the fence; prepare construction bidding documents; obtain permits and approvals; secure construction bids; and monitor and document fence construction, and installation of groundwater monitoring wells and indoor air monitoring probes.

Local contractors would be able to accomplish the construction work under this option. The construction materials would be readily available. There would likely only be limited construction difficulties related to installation of the fence, groundwater monitoring wells, and indoor air monitoring probes.

Permits from the MDOT and HCRC would be required for installation and maintenance of groundwater monitoring wells and for completing environmental monitoring activities within the ROW of State Highway M-26 and Franklin Street, respectively. Authorization to access private property would also be required to construct the fence, groundwater monitoring wells and/or indoor air monitoring probes, to maintain/replace the fence, groundwater monitoring wells and indoor air monitoring probes, to obtain groundwater, surface water, indoor air quality and storm water samples, to perform soil sampling beneath the floor of on-site buildings, and to collect samples of the highly contaminated soil.

Deed restrictions would be required to limit land and groundwater uses, prohibit new utility installation in contaminated areas, limit changes to the ground surface or fence, monitor any work within the Plant Site, and to require persons to obtain MDEQ approvals for such activities. If deed restrictions were impractical, governmental agencies would need to place land and groundwater use restrictions on the Plant Site. Notifications to utilities would also be made to advise them of the presence of contaminated soil and groundwater near or around existing utilities, the need to obtain access authorization and safety controls, and a contaminated materials management program when performing subsurface work.

Because reduction of contaminant mass would depend entirely on natural attenuation, the timeframe for restoration of the contaminated soil and groundwater media will be long. As with Alternative 1, the timeframe is likely to be far longer than the elapsed time period since the coal tar waste has been released (estimated at greater than 75 years). It is probable that natural attenuation alone would not provide for restoration of the Plant Site.

It is estimated that the minimum timeframe to close the site under an alternative that does not greatly reduce contaminant mass in the short-term would be at least 30 years. This would require regulatory and public acceptance, including a risk assessment which would conclude that there is an acceptable level of risk to the public health, safety and welfare and the ecosystem if the contamination is left in place and that the collected environmental monitoring data supports this conclusion. The present worth analysis of this alternative will therefore evaluate estimated costs over a 30-year period.

Construction of the fence, groundwater monitoring wells and indoor air monitoring probes would result in limited operation of vehicles and equipment during daylight hours. These operations would cause noise, traffic, and air (exhaust fumes) short-term impacts to area residents. Limited short-term disruption of PGC's operation on the PGC property might also occur. No short-term increased risk to the ecosystem is expected to result by implementation of this alternative. Long-term impacts would persist as the mass and toxicity of contaminants will not be reduced. In addition, no efforts would be made to control the mobility of the contaminants.

Because Alternative 2 includes fencing, environmental monitoring, and other institutional controls, there would be an expense associated with its implementation. As such, the present worth of this alternative was calculated. The discount rate factor, as determined by the USEPA of 6.875 percent, was used in the calculation. The time period over which costs were considered in the present worth analysis is 30 years.

The present worth for this alternative is $2,889,889. The present worth of Alternative 2 is the next lowest after Alternative 1 – No Action.

The capital costs include the removal of the old fence and construction of a new fence with hazard warning signs and the installation of groundwater monitoring wells and indoor air monitoring probes. The capital costs would also include administrative expenses and all engineering efforts required to implement this alternative as well as preparation of reports documenting the construction work and a public involvement process. The total capital costs are estimated to be approximately $513,950.

Occasional maintenance of the fence, groundwater monitoring wells, and indoor air monitoring probes throughout their lifetime would be necessary. The capital costs include the fence and hazard-warning signs, which have been estimated to have a 20-year useful life and would therefore be completely replaced once over the present worth analysis period. The estimated long-term operation and maintenance present worth cost over 30 years for this alternative is $152,349.

The environmental monitoring costs would be recurring expenses over the entire 30-year present worth analysis period. Annual reporting of site conditions with detailed analysis of collected data every 5 years would also occur. The monitoring program is considered a conservative estimate, and hence the estimated costs could likely be reevaluated during actual implementation. The estimated long-term environmental monitoring present worth cost over 30 years for this alternative is $2,215,270.

A future cost would also be needed to prepare a risk assessment of remaining environmental impacts and a closure documentation request for the Plant Site. For cost estimating purposes, this future cost has been assumed to occur at the end of the 30-year present worth analysis period. The estimated present worth of the future cost is $8,320.

The detailed cost estimate for this remedial alternative is included in Appendix B.

The potential future liability for this alternative would be the highest of all the alternatives except for Alternative 1 - No Action. Soil direct contact exposure controls are provided for the public but not for PGC's workforce to the shallow soil and storm water contamination. This would also be true for any utility workers having to work on existing utilities in contaminated locations. Health and safety requirements would help to minimize the exposure, but to a lesser degree than other more aggressive alternatives. Since all of the contamination present on the Plant Site would be left in-place, the overall risk from indoor air inhalation is greater than an alternative with limited removal, although the actual indoor air risk from the contamination present is currently unknown. The long-term monitoring associated with this alternative does provide for some liability protection. No reduction in contaminant mass or mobility would occur.

8.4 ALTERNATIVE 3 – ENGINEERED CONTROLS (IMPERMEABLE COVER)

8.4.1 Description of the Remedial Alternative

The remedial response considered under this alternative would be to eliminate direct contact by humans with readily accessible highly contaminated soil existing on the PGC property by means of engineered controls. This would be achieved by constructing an impermeable cover in the form of an asphalt cap over the contaminated areas that are not already covered, and through the installation of a new fence to limit direct contact exposures. The existing cover over all other areas of the Plant Site would be maintained.

In this alternative, institutional controls would also be implemented to impose certain land and groundwater use restrictions on the Plant Site. These restrictions would be imposed in order to further protect the health, safety, and welfare of the public and industrial workers from the potential of direct contact with the contaminated soil, groundwater and storm water. Like Alternative 2, this alternative would also provide the means to understand the potential risk of exposure to inhalation of contaminated indoor air through implementation of an IAMP. This alternative would not include any significant removal of contaminated materials. Only surficial soils would be removed to ensure a properly designed cap, allowing for placement of engineered subbase materials. More highly contaminated materials at a depth greater than 2 feet would remain in place. Installation of active indoor air control systems would not occur. Reduction in contaminant mass would rely mainly on natural attenuation.

The impermeable cover would consist of a bituminous cap over and slightly beyond the highly contaminated soil area. In order to construct the bituminous cap, preparation of the ground surface, on and around the PGC property, will need to be completed first. This would be accomplished by removal of up to 24 inches of existing material. Virtually all material that would need to be removed, with the exception of the existing bituminous surface, is considered to be contaminated and would be brought to an approved licensed landfill for disposal. Approximately 5,300 tons of contaminated material would need to be disposed. Approximately 1,700 tons of non-contaminated material is also estimated to be disposed as well. The contaminated soil would be directly loaded into transport vehicles. Materials with excessive moisture would be mixed with other contaminated materials to enable better handling and transport without spillage.

Construction equipment and vehicles would be restricted to specific roadways in the Florida Location. All excavated materials, whether contaminated or not, would be transported off-site. Manifests would be required for all media transported off-site. Loaded transport vehicles leaving the site would be required to be licensed to haul such waste. The transport vehicles would be allowed to travel in the most direct route to the point of disposal. The Waste Management, Inc. Landfill in Ontonagon, Michigan, was used for estimating purposes as the point of disposal for contaminated materials. The landfill is a non-hazardous MDEQ Type II licensed landfill and was used to dispose of the contaminated materials removed during the Residential Drainage Ditch Site remediation.

After removal of the contaminated soil, the underlying material would be visually inspected and screened with the use of a PID, but no soil samples would be collected from within the excavation to document the degree of contamination remaining. Air monitoring of the excavation would be necessary to insure safe conditions for the construction workers and area residents.

The excavation would then be backfilled with 12 inches of MDOT Class II sand and 8 inches of MDOT 22A crushed aggregate. Once the subbase has been placed, shaped and properly compacted, a 4-inch thick bituminous asphalt layer would be constructed to serve as the impermeable cover. A gravel shoulder would be constructed along the edge of the asphalt. A truck off-loading pad to deal with semi-truck traffic would also be installed near the propane ASTs. Maintenance of the asphalt would be required, including joint repair and surface restoration.

Erosion control measures, which would primarily include silt fences, would be installed along the perimeter of the construction zone prior to any construction activity in order to protect the undisturbed environment. Areas disturbed by construction activities would be restored to a similar condition by properly shaping the area and applying seed, fertilizer and mulch.

A culvert would also be installed through the railroad grade north of the PGC property to improve the drainage patterns and allow for an outlet of surface water which accumulates and ponds in the wetland on the east side of the railroad grade. Installation of these culverts will require surface water control and possibly diversion measures in order to complete construction.

Physical access restrictions would be accomplished by constructing a new fence around the perimeter of the PGC property and placing signs on the fence to warn that hazards are present. The fence would have three (3) strands of barbwire and five (5) large gates to accommodate PGC truck traffic. Maintenance of the fence and gates would be required.

Deed restrictions would be necessary to prevent any action which could affect the asphalt cap or disturb contaminated soil both underlying and beyond the asphalt cap. The deed restrictions would require that disturbance to the cap and contaminated soils and groundwater could not occur without an MDEQ approved plan. Also, groundwater use restrictions would be imposed by means of deed restrictions and/or controls through governmental permitting agencies.

Notification to utility companies regarding the presence of contaminated materials and any access restrictions would be required. Safety controls and a contaminated materials management program would be necessary when and if utility subsurface work occurs.

Long-term monitoring of the contaminated media and other environmental conditions would also occur. The environmental monitoring for groundwater, surface water, sampling of the highly contaminated soil over time, and indoor air quality would be the same as that defined under Alternative 2. The only change to the environmental monitoring program for Alternative 3 is an adjustment to storm water monitoring. A detailed environmental monitoring plan, IAMP, and SWPPP for the Plant Site would be prepared prior to initiating this alternative.

The IAMP would not be prepared to satisfy any laws or regulations for which PGC is responsible to comply with as it pertains to air quality associated with their current business operations and management practices on the PGC property. An inspection of the buildings would also be made to determine general maintenance that would need to be performed to reduce the potential for PGC employees to potential air contamination.

The SWPPP would not be prepared to satisfy any governing laws or regulations for which PGC is responsible to comply with as it pertains to storm water management associated with their current business operations and facility management practices on the PGC property. However, this SWPPP would need to be incorporated into and made a part of the PGC SWPPP. With the installation of the asphalt cap over portions of the PGC property, the near surface contaminated soils would be covered and not subject to leaching into storm water. Because of the asphalt cap, collection of storm water samples was not included in the evaluation of this alternative.

A review of collected data would be completed after each sampling event for all of the data collected. Reporting would be limited to the indoor air monitoring unless information from other monitoring programs would need to be brought forward.

As part of this alternative, PGC and others would need to obtain approval from the MDEQ for any work activities that involve surface disturbances, excavation, demolition, building modification, or in general any change to land use as they presently exist. The purpose of this requirement would not only be to advise MDEQ of intended on-site alterations but also to inform MDEQ of the environmental protection methods that would need to be implemented to safeguard the public and PGC workers and to properly manage contaminated soil, groundwater and storm water.

A summary of the results and findings of all environmental monitoring programs would be presented in an annual report and would also include details of operation and maintenance work performed, present collected environmental monitoring data, site observations, and note areas of concerns or issues that need follow-up. Every 5 years an evaluation of data from all environmental monitoring programs would be made to assess environmental conditions, evaluate changes in contaminants, and to consider if modifications to the monitoring plans are appropriate.

Once the Plant Site is ready for closure, documentation of overall conditions observed throughout the environmental monitoring program and at the time of closure would need to be prepared and submitted to MDEQ. A risk assessment of the effect of remaining contaminated soil and groundwater impacts as they relate to public health, safety and welfare and the ecosystem would need to be performed. Environmental standards and criteria in effect at the time of the request would be used in this evaluation.

8.4.2 Considerations of the Remedial Alternative

This alternative could comply with regulatory requirements. An impermeable cover would increase protection of human health, safety and welfare. Alternative 3 provides for the protection of both the public and the PGC workforce from direct contact of the readily accessible highly contaminated soil. Required utility and underground exposure on existing utilities and infrastructure in contaminated areas would still occur, but could be limited in degree through proper health and safety procedures. Effort to insure this safety would be required. The ecosystem is largely unaffected by this alternative except for the benefit from the removal of the contaminated soil. The impermeable cover would also reduce the availability of the contamination to the ecosystem.

Implementation of Alternative 3 would be similar to Alternative 2, but would require greater efforts because of the impermeable cover. It would necessitate engineering and administration efforts to complete designs of the fence and asphalt cap; prepare construction bidding documents; obtain permits and approvals; secure construction bids;

and to monitor and document contaminated soil removal, asphalt cap and fence construction, and installation of groundwater monitoring wells and indoor air monitoring probes. Environmental monitoring programs would also need to be developed and implemented.

Area contractors could accomplish the construction work under this alternative. The construction materials are also readily available. Pending formal acceptance, contaminated soil could be brought to a local landfill. Work activities will need to be coordinated with PGC to enable their continued operation while construction is being completed. The construction zone has limited open space to enable easy maneuvering of construction equipment. A fair amount of work using hand tools would be required for removal and replacement of materials because of underground utilities and PGC's on-site structures. Construction activities would be performed around PGC's on-site buildings and above ground facilities which will require extra care so as not to cause any damage.

Approval to dispose of the contaminated materials would need to be obtained from the landfill. Vehicles used to transport waste materials would need to be permitted for such activities. Groundwater monitoring permits would be required from the MDOT and HCRC. The air monitoring plan to be implemented during excavation of contaminated materials will need MDEQ approval. Authorization to access private property would also be required to construct, maintain and/or replace the impermeable cover, fence, groundwater monitoring wells, and indoor air monitoring probes, to obtain groundwater, surface water, and indoor air quality samples and to perform soil sampling.

Deed restrictions would be required to limit land and groundwater uses, changes to the capping system or fence, work within the Plant Site, and to obtain MDEQ approvals for such activities. If deed restrictions were impractical, governmental agencies would need to place land and groundwater use restrictions on the Plant Site. Notifications to utilities would also be made to advise them of the presence of contaminated soil and groundwater, the need to obtain access authorization, and the need for safety controls and a contaminated materials management program when performing subsurface work.

As with Alternatives 1 and 2, the timeframe for meeting clean-up criteria at the Plant Site due to contaminated soil and groundwater would be quite long. Although the impermeable capping system would reduce infiltration through the contaminated soil, reduction in contaminant mass would rely mainly on natural attenuation. The time period for restoration by natural attenuation without any significant source reduction would likely be greater than 75 years. It is probable that natural attenuation alone would not provide for restoration of the Plant Site.

It is estimated that the minimum timeframe to close the Plant Site under an alternative that does not greatly reduce contaminant mass in the short-term would be at least 30 years. This would require overall acceptance, including a risk assessment concluding that there is an acceptable level of risk to the public health, safety and welfare and the ecosystem if the contamination is left in place and that the collected environmental monitoring data supports this conclusion. The present worth analysis of this alternative will therefore evaluate estimated costs over a 30-year period.

Excavation of contaminated soil, the impermeable cover system, removal of the old fence and installation of the new fence, and the construction of groundwater monitoring wells and indoor air monitoring probes would result in limited operation of vehicles and equipment during daylight hours. These operations would cause noise, traffic, and air (exhaust fumes) short-term impacts to area residents. Disruption of PGC's operation would occur. No short-term increased risk to the ecosystem is expected to result by implementation of this alternative. Long-term impacts would persist as the mass and toxicity of contaminants would not be greatly reduced. The mobility of the contaminants should be reduced since the cap will extend over most of the contaminated soils on the PGC property.

The present worth for this alternative is $3,659,011. This alternative has the third lowest present worth cost.

The capital costs include the impermeable cover and work related to contaminated soil removal needed for its installation, removal of the old fence and construction of the new fence with hazard warning signs, the installation of groundwater monitoring wells and indoor air monitoring probes, and site restoration. The capital costs also include administrative expenses and all the engineering efforts required to implement this alternative as well as preparation of reports documenting the construction work and a public involvement process. The total capital costs are estimated to be approximately $1,274,244.

Maintenance of the asphalt cap and fence would be required to ensure serviceability. Occasional maintenance of the groundwater monitoring wells and indoor air monitoring probes throughout their lifetime would also be necessary. The capital costs would also include the fence and hazard warning signs, which have been estimated to have a 20-year useful life and would therefore be completely replaced once over the present worth analysis period. The estimated long-term operation and monitoring present worth cost over 30 years for this alternative is $235,953.

Annual reporting of site conditions with detailed analysis of collected data every 5 years would also occur. The monitoring program is considered a conservative estimate, and hence the estimated costs could likely be reevaluated during actual implementation. The environmental monitoring costs would be recurring expenses over the entire 30-year present worth analysis period as outlined above. The estimated long-term environmental monitoring present worth is $2,140,495.

A future cost would be incurred to prepare a risk assessment of remaining environmental impacts and a closure documentation request for the Plant Site. For cost estimating purposes, this future cost has been assumed to occur at the end of the 30-year present worth analysis period. The estimated present worth of the future cost is $8,320.

The detailed cost estimate for this remedial option is included in Appendix B.

The potential future liability under this alternative is marginally improved by including engineering controls with institutional controls. However, the potential liability with landfilling excavated contaminated material would remain with the generator of the waste.

Control of soil direct contact exposure for both the public and PGC's workforce is provided. Underground utility and infrastructure workers would be protected through the proper use of health and safety procedures. Long-term monitoring provides for some liability protection. However, no significant reduction in contaminant mass or mobility would occur.

8.5 ALTERNATIVE 4 – LIMITED SOURCE REMOVAL (LANDFILL) AND ENGINEERING CONTROLS (IMPERMEABLE COVER)

8.5.1 Description of the Remedial Alternative

Removal of the most readily accessible highly contaminated soils at the Plant Site would be the primary remedial activity of this alternative. The limited source removal process would be accomplished by means of excavation through the use of a backhoe where practical, hand tools or other construction equipment, with off-site disposal of the material at an approved licensed solid waste landfill. Confirmation samples of the remaining soil would be collected.

Other aspects of this alternative include removal of contaminated soil along the culvert crossing State Highway M-26 that serves the Franklin Street drainage ditch. Drainage improvements would be made to reduce the amount of surface water ponding on the east side of the railroad grade north of the Plant Site. Engineered controls similar to Alternative 3, including an impermeable cover and a security fence on the PGC property, would also be constructed.

In this alternative institutional controls would be implemented to impose certain land and groundwater use restrictions on the Plant Site in order to further protect the health, safety, and welfare of the public and industrial work force from the potential of direct contact with the contaminated soil and groundwater. Like Alternatives 2 and 3, this alternative would also provide the means to understand the potential risk of exposure to inhalation of contaminated indoor air through implementation of an IAMP. This alternative would not include installation of any active indoor air control systems. Reduction of the remaining contaminant mass would rely entirely on natural attenuation.

Source removal would be limited to the highly contaminated soil. In general, readily accessible material would be excavated from within the highly contaminated area as shown in Figures 3A and 3C. This includes most of Section 3 and the easterly part of Section 4 of the Plant Site. The contaminated soil, in the drainage ditch along the north side of Franklin Street, would also be removed to a practical limit. In addition, the southern parts of Sections 1 and 2 of the Plant Site near the former 100,000 cubic foot Gas Holder have been included because information suggests that greater impacts exist at this location than have been documented to date (i.e. exceeding industrial direct contact criteria).

Prior to proceeding with excavation work, a RAV sampling program would be performed. A RAV sampling program would include soil sampling in Sections 1, 2, and part of 3 to further define the degree of contamination. This would be performed to determine if the remedial alternative chosen is appropriate, based on the degree of contamination. Six (6) soil borings would be advanced to a depth of 10 feet BGS. Two (2) soil samples would be obtained from each boring. The laboratory analysis regime would be the same as that completed on soil samples collected in the Plant Site RI. A report of the analytical results and findings would be prepared.

The depth of contaminated soil removal would be limited to the upper portions of the above-described areas. The excavation depths are estimated to range from 6 to 8 feet BGS. The extent of the excavation would also be limited by underground utilities and to within a practical limit of buildings. Because of the possible presence of an underground coal tar tank near the Scale House in Section 3 of the Plant Site, this building would be expected to be demolished to allow for removal of this tank and then be reconstructed. Removal of bituminous surfaces and buried debris from former building facilities is also anticipated. Approximately 14,800 tons of contaminated material would be excavated.

The contaminated soil would be directly loaded into transport vehicles. Given the depth of the remediation work, some of the contaminated material is expected to have a high moisture content. Materials that have excessive moisture would be mixed with other excavated materials to enable better handling and transport without spillage. Off-site staging of contaminated materials for storage, processing or handling purposes should not be needed, but if a staging area is necessary, it would be located within the limits of excavation.

Construction equipment and vehicles would be restricted to specific roadways in the Florida Location. All excavated materials, whether contaminated or not, would be transported off-site. Loaded transport vehicles leaving the site will be required to be licensed to haul such waste. The transport vehicles would be allowed to travel in the most direct route to the point of disposal. For estimating purposes, the Waste Management, Inc. Landfill in Ontonagon, Michigan was used as the point of disposal of contaminated materials. The landfill is a non-hazardous MDEQ Type II licensed facility and was also used to dispose of the contaminated materials removed during the residential drainage ditch remediation.

After removal of the contaminated soils, the underlying material would be visually inspected and screened with the use of a PID. Samples would be collected from within the excavation to document the degree of contamination remaining. The sampling sites would be chosen in general accordance with the MDEQ VSR guidance document. Samples would be sent to a state-approved laboratory and analyzed for the analytical parameters similar to those completed for the Plant Site RI.

When necessary, water in the excavation would be collected and removed by a "vac-truck". The water would be hauled by a licensed liquid transport vehicle to an approved licensed treatment plant. On-site bulk liquid storage would be available to assure that adequate storage volumes are available to provide for efficient excavation operations and to handle emergency conditions. The treatment facility could either be a municipal wastewater treatment plant located in the region or a mobile treatment plant located near the excavation. The Gogebic-Iron Authority Wastewater Treatment Plant, in Ironwood, Michigan, was used for purposes of estimating costs.

All contaminated soil and water removed from the excavation would be transported off-site. Manifests would be required for all media transported off-site. Air monitoring of the excavation would also be necessary to insure safe conditions for the construction workers and area residents.

The excavation would be backfilled with clean material. This fill material would have low hydraulic conductivity characteristics with a certain percentage of fines (silt). It is anticipated that backfill with these characteristics would reduce the mobility of the remaining contaminate mass. The backfill would require certain structural qualities capable of handling the surface bearing loads. The backfill would be placed in lifts and properly compacted up to an elevation of 24 inches BGS. At this point, the backfill would be changed to meet the design requirements of an engineered control impermeable cover (asphalt cap and truck-off loading pad) similar to that described for Alternative 3. Subgrade undercut would occur in the remaining unexcavated areas. The impermeable cover asphalt cap backfill material would consist of 12 inches of MDOT Class II sand and 8 inches of MDOT 22A crushed aggregate. Once the impermeable cover subbase has been placed, shaped and properly compacted, a 4 inch bituminous asphalt layer would be constructed. A gravel shoulder would be constructed along the edge of the asphalt. A semi-truck off-loading pad, near the existing Propane ASTs, would also be constructed. Maintenance of the asphalt would be required, including joint repair and surface restoration.

A new culvert crossing State Highway M-26 would be installed and the roadway surface above the culvert would be restored to match existing conditions after contaminated material removal has been completed in this area. A culvert would also be installed in the railroad grade north of the Plant Site to improve the drainage patterns and allow for an outlet of surface water which ponds in the wetland on the east side of the railroad grade. Installation of these culverts would require surface water control and possible diversion measures in order to complete construction.

Erosion control measures, including silt fences, hay bales and, if needed, sedimentation traps, would be installed along the perimeter of the construction zone prior to any construction activity in order to protect the undisturbed environment. All areas disturbed by construction activities, and not receiving an asphalt cap, would be restored to a similar condition by properly shaping the area and applying seed, fertilizer and mulch.

Physical access restrictions would be accomplished by constructing a new fence around the perimeter of the PGC property and placing signs on the fence to warn that hazards are present. The fence would have three (3) strands of barbwire and five (5) large gates to accommodate PGC truck traffic. Maintenance of the fence and gates would be required.

Institutional controls consisting of deed restrictions would be necessary to prevent any action which could affect the asphalt cap or disturb contaminated soil that might remain under or beyond the asphalt cap. The deed restrictions would require that work could not occur without an MDEQ approved plan. Also, groundwater use restrictions would be imposed by means of property deed restrictions and/or controls through governmental permitting agencies.

Notification to utility companies regarding the presence of contaminated materials and access restrictions would need to be performed. Safety controls and a contaminated materials management program would be necessary when and if utility subsurface work occurs.

In this alternative, long-term monitoring of the contaminated media and other environmental conditions would be implemented in a similar fashion to that proposed for Alternative 3, although the length of required monitoring would be expected to be shorter; approximately 20 years. The environmental monitoring for groundwater, surface water, sampling of the highly contaminated soil over time, indoor air quality, and storm water would all be the same as that defined under Alternative 3. The only change to the environmental monitoring program for Alternative 4 relates to the number of groundwater monitoring wells. A detailed environmental monitoring plan, IAMP and SWPPP for the Plant Site would be prepared prior to initiating this alternative.

Because of contaminated soil removal activities, there would be a need to abandon eleven (11) of the existing twenty-five (25) groundwater monitoring wells under Alternative 4. It is estimated that only seven (7) out of the eleven (11) existing groundwater monitoring wells abandoned would be replaced but in slightly different locations. In addition, like Alternatives 2 and 3, six (6) new groundwater monitoring wells would also be constructed and two (2) soil samples would be obtained from each new well location at the time of installation. A total of twenty-seven (27) wells would be sampled in each monitoring event.

The IAMP would not be prepared to satisfy any laws or regulations for which PGC would be responsible to comply with as it pertains to air quality associated with their current business operations and management practices. An inspection of the buildings would also be made to determine general maintenance that would need to be performed to reduce the potential for exposure to air contamination.

The SWPPP would not be prepared to satisfy any laws or regulations for which PGC would be responsible to comply with as it pertains to storm water management associated with their current business operations and management practices. However, this SWPPP would need to be incorporated into, and made a part of, the PGC SWPPP. With the installation of the asphalt cap over the PGC property, any remaining contaminated soils would be covered and not subject to leaching into storm water.

A review of collected data would be completed after each sampling event for all of the data collected. Reporting would be limited to the indoor air monitoring unless information from other monitoring programs would need to be brought forward.

As part of this alternative, any work within the asphalt cap or highly contaminated area that involves surface disturbances, excavation, demolition, building modification, or in general any change to current conditions would need approval from the MDEQ. The purpose of this requirement would not only be to advise MDEQ of intended on-site alterations but also to inform MDEQ of the environmental protection methods that would need to be implemented to safeguard the public and PGC workers and to properly manage contaminated soil and groundwater.

A summary of the results and findings of all environmental monitoring programs would be presented in an annual report and would also include details of operation and maintenance work performed, present collected environmental monitoring data, identify site observations, and note areas of concerns or issues that need follow-up. Every 5 years an evaluation of data from all environmental monitoring programs would be made to assess environmental conditions, evaluate changes in contaminants, and to consider if modifications to the monitoring plans are appropriate.

Once the Plant Site is ready for closure, documentation of Plant Site conditions observed throughout the environmental monitoring program and that exist at the time of closure would need to be prepared and submitted to MDEQ. A risk assessment of the effect of remaining contaminated soil and groundwater impacts, as they relate to public health, safety and welfare and the ecosystem, would need to be performed. Environmental standards and criteria, in effect at the time of the request, would be used in this evaluation.

8.5.2 Considerations of the Remedial Alternative

Alternative 4 would comply with regulatory requirements. The impermeable cover would be protective of human health, safety and welfare. This alternative provides for the protection of both the public and PGC workforce from direct contact of the readily accessible highly contaminated soil. The risk of exposure to underground utility and infrastructure workers would also be greatly reduced from completion of removal activities. It should be noted that some contaminated utility trenches would remain. In addition, because most of the buildings on the PGC property would remain in place, there would also be some level of contamination that would not be removed. Although contaminant mass would be reduced, a certain level of risk and contaminant migration potential would remain.

The ecosystem would likely improve through removal of a portion of highly contaminated soils. However, the remaining highly contaminated soils could still present an ecological risk. The impermeable cover would also reduce the availability of the contamination to the ecosystem. Unlike Alternatives 2 and 3, this alternative would also provide a significant reduction in contaminant mass at the Plant Site.

Implementing Alternative 4 would be similar to Alternative 3, but would be more difficult than Alternative 3 because a greater amount of contaminated soil would be removed. Alternative 4 would require engineering and administration efforts to perform the RAV sampling program, complete designs, prepare construction bidding documents, obtain permits and approvals, secure construction bids, and to monitor and document contaminated soil removal, asphalt cap and fence construction, and installation of groundwater monitoring wells and indoor air monitoring probes. Environmental monitoring programs would also need to be developed and implemented.

Local contractors could accomplish the construction work under this alternative. Pending approval, disposal of contaminated media would be brought to a local landfill and municipal wastewater treatment plants. Like Alternative 3, construction difficulties are expected due to on-site logistics. Work activities would need to be coordinated with PGC to enable continued operation on the PGC property while construction occurs. The construction zone has limited open space to enable easy maneuvering of construction equipment. A fair amount of work using hand tools would be required, for removal and replacement of materials, because of underground utilities and PGC's on-site buildings. Construction work would need to be performed around PGC's on-site buildings and above ground areas, which would require extra care, so as not to cause any damage. Unstable and/or wet soil conditions are anticipated at lower depths of the excavation. Management of water in the excavation and surface water in the drainage ditch and wetland area could also affect the progress of construction work.

Approval to dispose of the contaminated materials would need to be obtained from the landfill and municipal wastewater treatment plant. Vehicles used to transport waste materials would need to be permitted for such activities. Permits to construct groundwater monitoring wells and to access for sampling and maintenance would need to be secured from the MDOT and HCRC for work in the ROWs of State Highway M-26 and Franklin Street, respectively. The air monitoring plan to be implemented during excavation of contaminated materials would need MDEQ approval. Authorization to access private property would also be required to construct, maintain and/or replace the impermeable cover, fence, groundwater monitoring wells, and indoor air monitoring probes, to obtain groundwater, surface water, and indoor air quality samples, to perform soil sampling beneath the floor of on-site buildings, and to collect samples of the remaining contaminated soil.

Deed restrictions would be required to limit land and groundwater uses, changes to the capping system or fence, work within the Plant Site, and to obtain MDEQ approvals for such activities. If deed restrictions were impractical, governmental agencies would need to place land and groundwater use restrictions on the Plant Site. Notifications to utilities would also be made to advise them of the presence of remaining contaminated soil and of contaminated groundwater, the need to obtain access authorization, and the need for safety controls and a contaminated materials management program when performing subsurface work.

The timeframe for restoration of the Plant Site would be improved because of the removal of the most highly contaminated soil. Following source reduction, natural attenuation would further reduce contaminant concentration. The time period for complete restoration by natural attenuation would be long, but under this option is expected to be faster than the other alternatives.

The minimum timeframe to close the site under an alternative which would greatly reduce the contaminant mass in the short-term would be approximately 20 years. This would require overall acceptance, including a risk assessment which would conclude that there is an acceptable level of risk to the public health, safety and welfare and the ecosystem if the contamination is left in place and that the collected environmental monitoring data supports this conclusion. The present worth analysis of this alternative was therefore evaluated using estimated costs over a 20-year period.

Construction associated with excavation of contaminated soil, backfilling operations, the impermeable cover system, removal of the old fence and installation of the new fence, and the construction of groundwater monitoring wells and indoor air monitoring probes would result in operation of vehicles and equipment during daylight hours. These operations would cause noise, traffic, and air (exhaust fumes) short-term impacts to area residents. Limited short-term disruption of PGC's operation on their property would occur. Removal of and disturbance of contaminated materials would also have the potential to release air pollutants on a short-term basis throughout the construction period. No short-term increased risk to the ecosystem is expected to result by implementation of this alternative. Long-term impacts would be significantly controlled as the mass and the toxicity effects of the contaminants would be greatly reduced. The mobility of the contaminants would also be significantly controlled because of the reduction of the contaminated soil mass and the installation of the impermeable cover.

The present worth for this alternative is $4,456,072. This alternative has the second highest present worth cost.

The capital costs include the excavation of contaminated soil, pumping and treating water that enters the excavation, disposing of contaminated materials in an approved licensed landfill and municipal wastewater treatment plant, surface water control and/or diversion system, installation of culverts, backfilling, construction of the impermeable cover, removal of the old fence and construction of the new fence with hazard warning signs, air monitoring, erosion control, installation of groundwater monitoring wells and indoor air monitoring probes, and site restoration. The capital costs also include administrative expenses and all the engineering efforts required to implement this alternative as well as preparation of reports documenting the construction work and a public involvement process. The estimated capital cost for this alternative is $2,462,145.

Maintenance of the impermeable asphalt cap and fence would be required to ensure serviceability. Occasional maintenance of the groundwater monitoring wells and indoor air monitoring probes throughout their lifetime would also be necessary. Annual reports documenting work performed, environmental monitoring results, and observation of site conditions would be completed. The estimated long-term operation and maintenance present worth cost over 20 years for this alternative is $182,472.

Environmental monitoring of groundwater, surface water and indoor air quality would be undertaken. Reports of indoor air quality results would be provided after each monitoring event. The monitoring program is considered a conservative estimate, and hence the estimated costs could likely be reevaluated during actual implementation. A detailed analysis of collected environmental monitoring data would also occur every 5 years. The environmental monitoring costs would be recurring expenses over the entire 20-year present worth analysis period as outlined above. The estimated long-term environmental monitoring present worth is $1,796,199.

A future cost would be needed to prepare a risk assessment of remaining environmental impacts and a closure documentation request for the Plant Site. For cost estimating purposes, this future cost has been assumed to occur at the end of the 20-year present worth analysis period. The estimated present worth of the future cost is $15,256.

The detailed cost estimate for this remedial option is included in Appendix B.

The potential future liability associated with limited source removal, combined with engineered controls and institutional controls, would be much less than Alternatives 1, 2 and 3 since the amount of highly contaminated soils left in place would be greatly reduced. However, the potential liability with landfilling contaminated material would have to be considered. Institutional and engineering controls would need to be provided to help protect both the public and PGC's workforce. The contaminant mass would be greatly reduced, providing for a reduction in potential contaminant mobility. Long-term monitoring also provides for further liability protection.

8.6 ALTERNATIVE 5 – LIMITED SOURCE REMOVAL (LANDFILL) AND ENGINEERING CONTROLS (IMPERMEABLE COVER AND GROUNDWATER TREATMENT)

8.6.1 Description of the Remedial Alternative

Alternative 5 is identical to Alternative 4, except that groundwater treatment and to some degree contaminated saturated soil treatment would also be provided. Under this option, the health, safety and welfare of the public and PGC's workforce would be protected. The risk of exposure to underground utility and infrastructure workers would also be greatly reduced from completion of removal activities and some of these highly contaminated areas. However, some contaminated utility areas would still remain, requiring proper health and safety procedures. As with all of the other alternatives, by leaving the existing buildings in place, some level of contamination would also remain. Although the overall contaminant mass present would be reduced, a certain level of risk and contaminant migration potential would remain. It should be noted that this alternative would also be expected to reduce contaminant mass through injection of oxygenated air to increase natural attenuation rates through aerobic degradation. It is assumed that the rate of sparging would be low, designed to enhance aerobic degradation and not to strip contaminants from groundwater, hence the term bio-air sparge. It is therefore assumed that a soil vapor extraction system would not be required. Through proper implementation, this alternative could also reduce contaminant migration potential. The addition of groundwater treatment would enhance the improvement of the ecosystem.

Every aspect of Alternative 4 would be the same for Alternative 5, including but not limited to the following:

- Acquisition of all permits, approvals and private property access;
- RAV sampling program in the southern part of Sections 1 and 2 of the Plant Site;
- Location and amount of contaminated material to be removed;
- Methods for excavation, handling, loading and transporting of contaminated materials;
- Landfilling of contaminated materials;
- Inspection, VSR sampling, and testing of open excavation and remaining materials;

- Removal, handling, and treatment of water from the excavation;
- Manifesting of contaminated materials transported off-site;
- Excavation air monitoring and indoor air monitoring;
- Type of backfill materials and placement operations;
- Erosion control measures;
- Culvert installations;
- Impermeable cover asphalt cap construction;
- Site restoration activities;
- Security fence construction;
- Land and groundwater use property restrictions and governmental controls;
- Utility company notifications;
- Environmental monitoring plans including the IAMP and SWPPP;
- Inspection of PGC buildings for general maintenance to reduce potential air contamination exposure;
- Long-term monitoring and sampling programs excluding storm water and as modified below;
- Review of collected data and reporting of results and findings;
- Notification of MDEQ by PGC of modifications or improvements to the PGC property; and
- Plant Site future risk assessment and closure request.

The IAMP and SWPPP would not be prepared to satisfy any laws or regulations on behalf of PGC. However, the SWPPP would need to be incorporated into the PGC SWPPP.

In this alternative, long-term monitoring of the contaminated media and other environmental conditions would be implemented in a similar fashion to that proposed for Alternative 4. Environmental monitoring for groundwater, surface water, sampling of the highly contaminated soil over time, indoor air quality, and storm water would all be the same. The only change to the environmental monitoring program for Alternative 5 relates to the number of groundwater monitoring wells.

As a result of the removal activities, eleven (11) existing groundwater monitoring wells would be abandoned and seven (7) of the eleven (11) wells would be replaced. In addition, ten (10) monitoring wells would be constructed and two (2) soil samples would be obtained from each new well location at the time of installation. A total of thirty-one (31) wells would be sampled in each monitoring event.

Groundwater treatment would be accomplished by air sparging. Air would be discharged below the groundwater table to allow for oxygen transfer into the groundwater to promote biological degradation of the contaminant. It is feasible that the oxygenated groundwater would also assist in the treatment of saturated contaminated soils present below the groundwater table elevation. The system would be constructed using bio-air sparge injection points, compressor, and interconnecting piping. The compressor would be housed in a small building located on-site, including all necessary instrumentation and controls for system operation. The building would require electrical service, heating and proper ventilation. The treatment building is currently planned to be located in the eastern part of Section 4 of the PGC property.

To adequately design the bio-air sparging system, a field pilot test would be performed on the PGC property. Because of the possibility that bio-air sparging may be limited by natural conditions including groundwater dissolved iron and hardness, the pilot test would also be structured to consider a groundwater pump and treatment system. Sparging would be preferred as it would likely provide greater assistance in reducing contaminant mass. The field activities would consist of a sparge test and a groundwater pumping test. To complete the field pilot tests, air injection/extraction wells, observation wells, and a 6-inch diameter groundwater pumping well would be constructed. Groundwater recovered during the pump test would be carbon treated. It is assumed that the treated water would be discharged to the North Houghton County Sewerage Authority sanitary wastewater collection system. Groundwater samples would also be obtained and sent to the laboratory for analysis of parameters similar to those completed for the RI and other analytical parameters including, but not limited to, hardness, total and dissolved iron, alkalinity. Design parameters including injection pressures, radius of influence, flow rates, changes in groundwater contaminant levels, groundwater dissolved oxygen, redox potential, and potential affect on natural attenuation processes would also be determined during the pilot test activities.

After completion of the field pilot test, a review of compiled data and laboratory analytical results will be made to assess the feasibility of installing a bio-air sparge system or a groundwater pump and treatment system on the Plant Site. A report would be prepared to present the findings and to outline the basis of treatment system design. Implementation of either a bio-air sparge system or a pump and treat system would depend on the results of the testing to determine expected effectiveness. The present worth analysis for Alternative 5 assumes that a bio-air sparge system could be installed, any differences in the chosen system would require that the estimate be updated. The present worth would be significantly increased with a pump and treatment system because of increased capital costs, greater equipment operation and maintenance costs, and additional system operational monitoring costs.

Because bio-air sparging would force low flow rates of air into the groundwater, there is a small possibility that contaminants may be driven to the soil vapor environment. In order to monitor the build-up and/or release of contaminants to the soil, vapor monitoring probes would be installed around the PGC property. Ten (10) soil vapor monitoring probes would be placed around the perimeter of the PGC property and regularly sampled and monitored to assist in understanding the effects of the groundwater treatment system. The monitoring results, combined with monitoring from surrounding groundwater-monitoring wells would be used for operational control of the treatment system. Field instruments would generally be used to determine the concentration of certain parameters. Other samples obtained from the soil vapor monitoring probes would be laboratory analyzed for VOCs and SVOCs. The frequency of laboratory analysis of soil vapor samples would be the same as that scheduled for groundwater samples. Overall system effectiveness would also be analyzed.

8.6.2 Considerations of the Remedial Alternative

Alternative 5 could comply with regulatory requirements. The impermeable cover would be protective of human health, safety and welfare. This alternative provides for the protection of both the public and PGC workforce from direct contact of the readily accessible highly contaminated soil. Removal activities would reduce the risk of exposure to utility and infrastructure workers in some of these highly contaminated areas. However, some contaminated utility areas would still remain, requiring proper health and safety procedures. As with all of the other alternatives, by leaving the existing buildings in place, some level of contamination would also remain. Although the overall contaminant mass present would be lessened, this also suggests that a certain level of risk and contaminant migration potential would remain.

This alternative does provide a means, however, to reduce the remaining contaminant mass at a potentially faster rate than would occur without a treatment system, mainly through the injection of oxygenated air to increase natural attenuation rates through aerobic degradation. This suggests that the alternative would possibly be the most effective in reducing overall contaminant mass. Unlike Alternative 4, this alternative would also serve to greatly reduce contaminant mass migration.

The ecosystem would be greatly improved by the removal of highly contaminated soil and the treatment of groundwater. The impermeable cover would also reduce the availability of the contamination to the ecosystem.

Implementation of Alternative 5 would require the same type of effort as Alternative 4, including extra work tasks and efforts related to the groundwater treatment system. It would require engineering and administration efforts to perform the RAV sampling program, complete designs, prepare construction bidding documents, obtain permits and approvals, secure construction bids, and to monitor and document contaminated soil removal, groundwater treatment system, asphalt cap and fence construction, and installation of groundwater monitoring wells, indoor air monitoring probes and soil vapor monitoring probes. Environmental monitoring programs, similar to Alternative 4, would also need to be developed and implemented with the addition of a soil vapor monitoring program.

Local contractors could accomplish the construction work under this alternative. If local contractors were to perform the work, a subcontractor for installation of the groundwater treatment system might be needed. Pending approval, contaminated media could be disposed of at a local landfill and municipal wastewater treatment plants. Work activities would need to be coordinated with PGC to enable continued operation on the PGC property by PGC during construction. The construction zone has limited open space to enable easy maneuvering of construction equipment. A fair amount of work, using hand tools, would be required for removal and replacement of materials because of underground utilities and PGC's on-site buildings. Construction work would need to be performed around PGC's on-site buildings and above ground buildings which would require extra care, so as not to cause any damage. Unstable and/or wet soil conditions are anticipated at lower depths of the excavation. Management of water in the excavation and surface water in the drainage ditch and wetland area could also affect construction work production.

Approval to dispose of the contaminated materials would need to be obtained from the landfill and municipal wastewater treatment plant. Vehicles used to transport waste materials would need to be permitted for such activities. Permits to construct groundwater monitoring wells and to access for sampling and maintenance would need to be secured from the MDOT and HCRC for work in the ROWs of State Highway M-26 and Franklin Street, respectively. The air monitoring plan, to be implemented during excavation of contaminated materials, would need MDEQ approval. Authorization to access private property would also be required to construct, maintain and/or replace the impermeable cover, fence, groundwater monitoring wells, indoor air monitoring probes and soil vapor monitoring probes, to obtain groundwater, surface water, indoor air quality, and soil vapor samples, to perform soil sampling beneath the floor of on-site buildings, and to collect samples of the remaining contaminated soil.

Deed restrictions would be needed to limit land and groundwater uses, changes to the capping system or fence, work within the Plant Site, and to obtain MDEQ approvals for such activities. If deed restrictions were impractical, governmental agencies would need to enact institutional controls to limit the uses of land and groundwater on the Plant Site. Notifications to utilities would also be made to advise them of the presence of remaining contaminated soil and of contaminated groundwater, the need to obtain access authorization, and the need for safety controls and a contaminated materials management program when performing subsurface work.

Like Alternative 4, the timeframe under this option to restore the Plant Site would be improved because of the removal of the most highly contaminated soil and the installation of a groundwater treatment system. After source reduction has occurred, the process that would further reduce contaminated soils is natural attenuation, whereas groundwater contaminant reduction would be enhanced by the bio-air sparging system. Even with the inclusion of the groundwater treatment system, the time period for restoration would be long, but under this option is expected to be faster than the other alternatives. It is probable that natural attenuation of remaining contaminated soil would not provide for restoration of the Plant Site.

It is estimated that the minimum timeframe to close the site, under an alternative which would greatly reduce the contaminant mass in the short-term and treat groundwater over the long-term, would be approximately 20 years. This would require overall acceptance, including a risk assessment which would conclude that there is an acceptable level of risk to the public health, safety and welfare and the ecosystem if the contamination is left in place and that the collected environmental monitoring data supports this conclusion. The present worth analysis of this alternative was, therefore, evaluated for estimated costs over a 20-year period.

Construction associated with excavation of contaminated soil, backfilling operations, the impermeable cover system, removal of the old fence and installation of the new fence, the groundwater treatment system, and the construction of groundwater monitoring wells, indoor air monitoring probes and soil vapor monitoring probes would result in operation of vehicles and equipment during daylight hours. These operations would cause noise, traffic, and air (exhaust fumes) short-term impacts to area residents. Limited short-term disruption of PGC's operation would occur. Removal and disturbance of contaminated materials would also have the potential to release pollutants to the air on a short-term basis throughout the construction period. No short-term increased risk to the ecosystem is expected to result by implementation of this alternative. Long-term impacts will be significantly controlled as the mass and the toxicity effects of the contaminants would be greatly reduced. The mobility of the contaminants would also be significantly controlled because of the mass reduction of the contaminated soil, the installation of the impermeable cover and the construction of the groundwater treatment system.

The present worth for this alternative is $5,374,400. This alternative has the highest present worth cost.

The capital costs include the excavation of contaminated soil, pumping and treating water that enters the excavation, disposing of contaminated materials in an approved licensed landfill and municipal wastewater treatment plant, surface water control and/or diversion system, installation of culverts, backfilling, construction of the impermeable cover, removal of the old fence and construction of the new fence with hazard warning signs, construction of the groundwater treatment system, indoor air monitoring, erosion control, installation of groundwater monitoring wells, indoor air monitoring probes and soil vapor monitoring probes, and site restoration. The capital costs also include administrative expenses and all the engineering efforts required to implement this alternative as well as preparation of reports documenting the construction work and a public involvement process. The estimated capital cost for this alternative is $2,761,695.

Maintenance of the impermeable asphalt cap and fence would be required to ensure serviceability. Equipment operation and maintenance associated with the groundwater treatment system would be needed. Occasional maintenance of the groundwater monitoring wells, indoor air monitoring probes and soil vapor monitoring probes throughout their lifetime would also be necessary. Annual reports documenting work performed, environmental monitoring results, and observation of site conditions would be completed. The estimated long-term operation and monitoring present worth cost over 20 years for this alternative is $454,425.

Environmental monitoring of groundwater, surface water, indoor air quality and soil vapor would be undertaken. Reports of indoor air quality results would be provided after each monitoring event. A detailed analysis of collected environmental monitoring data would also occur every 5 years. The monitoring program is considered a conservative estimate, and hence the estimated costs could likely be reevaluated during actual implementation. The environmental monitoring costs would be recurring expenses over the entire 20-year present worth analysis period as outlined above. The estimated long-term environmental monitoring present worth is $2,143,024.

A future cost would be needed to prepare a risk assessment of remaining environmental impacts and a closure documentation request for the Plant Site. For cost estimating purposes, this future cost has been assumed to occur at the end of the 20-year present worth analysis period. The estimated present worth of the future cost is $15,256.

The detailed cost estimate for this remedial option is included in Appendix B.

This alternative provides the least potential future liability. However, as with Alternative 4, the potential liability associated with landfilling contaminated material would be given consideration. Soil direct contact exposure controls are provided for both the public and PGC's workforce. The contaminant mass is greatly reduced which will provide for a reduction in contaminant mobility. Long-term groundwater treatment and environmental monitoring also provides for further liability protection.

9.0 SELECTION OF REMEDIAL OPTION

The remedial alternatives, that have been chosen to undergo detailed analysis, display various levels of protection to human health and the environment. They range from no improvement to control of direct contact exposure, limited source reduction, and remaining in-situ contaminant treatment. Implementation of an alternative may range from no action to requiring an extensive effort for design, securing approvals, construction, coordination with private property owners, and long-term environmental monitoring. The time period for natural attenuation without any source reduction is likely to be far longer than the time that has already elapsed (estimated at great than 75 years) since the coal tar waste has been deposited on the Plant Site. For estimation purposes, closure time frames have been estimated to 30 years with no source reduction and 20 years with a reduction in the contaminant mass. The expenses associated with implementing an alternative can range from no cost to a significant cost depending on the aggressiveness of the option.

In the selection of a remedial alternative, consideration must be given to the level of protection of human health, safety and welfare as well as the degree of environmental improvement. To assist with selection of a remedial alternative, each option was evaluated against technical and economic feasibility criteria. Each alternative was reviewed with respect to overall protectiveness to humans and the environment, short and long-term effects, implementability, restoration timeframe, and costs. A numerical ranking system was used to help compare the remedial alternatives as shown on Table 4. The evaluation criteria are noted, a brief description of whether the alternative meets the criteria is provided, and a numerical rating is presented. A summary of each alternative's comparison is provided below.

After completing of the alternative comparison evaluation, selection of an alternative or alternatives was made. Justification for the selection and recommendation of an alternative(s) for final consideration is presented thereafter.

9.1 ALTERNATIVE 1 – NO ACTION

Without proceeding to implement some type of a remedial action, conditions within the Plant Site will continue to cause environmental degradation. A "no action" alternative would allow contaminated soil and groundwater to remain without controls. The potential migration of these contaminants, via groundwater and surface water transport, would be unaffected. This alternative has the lowest ranking score (77) and would do nothing to reduce future liability risks. For all of these reasons, Alternative 1 - No Action does not appear to be an acceptable solution.

9.2 ALTERNATIVE 2 – INSTITUTIONAL CONTROLS

At a minimum, there are readily implementable controls that could provide for at least some protection to direct human contact. A fence with hazard warning signs would restrict access to the Plant Site, the location of the most contaminated soil. Deed restrictions would provide notification of contaminants present and control activities within the area of contamination. While this alternative would be protective of public health, safety and welfare and PGC workforce, it would be less protective than other more aggressive alternatives. Institutional controls would be the primary mechanism to protect utility workers from exposures through direct contact. The alternative would depend mostly on the monitoring programs implemented to identify any areas of risk concern. Results of any monitoring could require additional engineering controls to obtain an acceptable level of protection.

The mass, toxicity and mobility of the contaminated soil and groundwater media would not be affected by this alternative. The ecosystem would not be protected although the overall ecological risk is unknown. Though this alternative is the least disruptive to the environment on a short-term basis and is not prohibitively expensive, there are no overall long-term benefits except for reducing human direct contact. Obtaining deed restrictions, without reducing future liability, may not be acceptable to property owners. This alternative also had a low ranking score (87) and was ranked fourth among the potential alternatives.

9.3 ALTERNATIVE 3 - ENGINEERING CONTROLS (IMPERMEABLE COVER)

This alternative provides for a greater level of protection than Alternatives 1 and 2. Direct contact with contaminated soil, storm water run-off, and groundwater by the public and the PGC workers would be largely eliminated through installation of a physical barrier. Utility and underground worker exposure in contaminated areas could still occur, but could also be limited in degree through proper notifications and safety procedures. Efforts to insure that notifications and safety procedures are in place before working on existing utilities and infrastructure in the Plant Site would be required.

This alternative would also provide the means to understand the potential risks of exposure through environmental monitoring. This would be especially important in terms of defining potential indoor air inhalation risks. With an impermeable cover, the risk of exposure to indoor air contamination may be increased. Results of any monitoring could possibly require additional engineering controls to obtain an acceptable level of protection.

This alternative would not include any significant removal of contaminated materials. Only surficial soils would be removed to ensure a properly designed cap, allowing for placement of engineered subbase materials. More highly contaminated materials at depths greater than 2 feet BGS would remain in place. Reduction in contaminant mass would rely mainly on natural attenuation and the degradation rate would be quite slow.

The RI has demonstrated that contaminant migration is limited due to the nature of the coal tar waste and natural attenuation. However, implementation of this alternative would provide for a slight additional reduction in contaminant migration potential through reduction of infiltration.

Land and groundwater use restrictions would provide protection from remaining contamination. The ability to acquire deed restrictions could be difficult because the future liability would only be slightly reduced. Long-term environmental monitoring will allow for assessment of changing conditions. Minimal improvements of the ecosystem are expected, although the overall ecological risk is unknown. This alternative scored 92 and ranked second.

9.4 ALTERNATIVE 4 – LIMITED SOURCE REMOVAL (LANDFILL) AND ENGINEERING CONTROLS (IMPERMEABLE COVER)

This alternative builds upon the institutional controls and engineered controls of the previous alternatives and reduces the mass of contaminated material by removing some of the most highly contaminated soil. Unlike the previously considered alternatives, this alternative provides for a greater control of mobility and provides for a large reduction of contaminant mass.

The impermeable cover would help to protect human health, safety and welfare from contamination that remains in-place. The alternative would provide for the protection of both the public and PGC workforce from direct contact of the readily accessible highly contaminated soil. The risk of exposure to underground utility and infrastructure workers would also be greatly reduced. However, some contaminated utility corridors would still remain, requiring proper notification and safety procedures.

As with all of the other alternatives, some amount of highly contaminated soils would remain. Since, for the most part, existing structures and utilities would not be removed, contamination may be left in place under the PGC buildings and aboveground storage tanks, and around inaccessible utilities. Although the overall contaminant mass would be reduced, a certain level of risk and contaminant migration potential would remain. Indoor air inhalation risks could still be present. Results of any monitoring may require additional engineering controls to obtain an acceptable level of protection.

The ecosystem would likely be improved by the removal of a large portion of highly contaminated soils, although the actual site ecological risk is unknown. Remaining contamination could still present an ecological risk. The impermeable cover would also reduce the availability of the contamination to the ecosystem.

This alternative is more expensive to implement than Alternatives 1, 2, and 3 and land and groundwater use restrictions would likely be opposed. Future liabilities would be reduced but not eliminated. This alternative had a score of 95 and ranked first.

9.5 ALTERNATIVE 5 – LIMITED SOURCE REMOVAL (LANDFILL) AND ENGINEERING CONTROLS (IMPERMEABLE COVER AND GROUNDWATER TREATMENT)

Implementation of this alternative is essentially the same as that required for limited source removal and landfill disposal, except for one major difference. An on-site treatment system for contaminated groundwater would be included. Because of unknown natural conditions, the implementation of a groundwater treatment system will need to be pilot tested. This alternative has the potential of treating remaining saturated soil and groundwater contamination after a limited source removal. However, because the migration potential appears to be limited, the overall risks do not appear to warrant such an aggressive alternative, as the remaining risks are basically addressed by institutional and engineered controls completed in the same fashion as Alternatives 3 or 4. This alternative would provide the greatest reduction in future liability, provided it could be successfully implemented. The uncertainties associated with this option, along with the additional costs required to implement as opposed to limited source removal and landfilling, do not seem to be warranted. This alternative had a score of 89 and ranked third.

9.6 RECOMMENDED REMEDIAL ALTERNATIVES

Of the five (5) alternatives evaluated, the two (2) highest ranked, Alternative 3 – Engineered Controls (Impermeable Cover) and Alternative 4 – Limited Source Removal (Landfill) and Engineering Controls (Impermeable Cover) are recommended for final consideration.

Both alternatives provide for protection of human health, safety and welfare through the control of human exposure pathways. Alternative 4 accomplishes this more completely because of source reduction, but would be more difficult to implement. The main ecological difference between the two (2) alternatives is that Alternative 4 provides for a significant reduction in the contaminant mass.

Alternative 4 would be expected to bring the Plant Site closer to complete regulatory compliance faster than Alternative 3 due to the significant contaminant mass reduction that would occur in the short-term. This is typically more consistent with applicable regulations.

Community acceptance of any remedial action option should be considered with recommendation/implementation of a specific option. Community acceptance of a chosen remedial action may be dependent on cost associated with that option.

Depending on the actual importance of each of the feasibility study analysis criteria in Section 8.1 and as evaluated in the comparison-ranking Table 4, these two (2) alternatives might be considered desirable and could both be recommended for final consideration.

As previously described, the remedial action alternative evaluation was completed with the understanding that a NREPA Part 201 Remedial Action Plan can be developed. It should also be noted that the evaluation and recommendations were completed based upon the assumptions, conditions and understandings described throughout the Plant Site FS.

10.0 LIMITATIONS

The information contained in this report is based upon the data obtained from a limited number of soil and groundwater samples obtained from widely spaced subsurface explorations. Variations, in degree and extent of contamination between the points at which explorations occurred, may exist and may only become apparent as a result of further investigation. If other latent conditions then appear evident, it may be necessary to reevaluate the conclusions and recommendations of this report.

Water level observations have been made in the borings and/or monitoring wells at the times and under the conditions stated on the boring logs. Fluctuations in the level of groundwater may occur due to variations in rainfall and other factors different from those prevailing at the time measurements were made.

Where quantitative laboratory testing has been conducted by an outside laboratory, CEC has relied upon the data provided, and has not conducted an independent evaluation of the reliability of these data.

The conclusions and recommendations contained in this report are based in part upon various types of chemical data and are contingent upon their validity. These data have been reviewed and interpretations made in this report. Variations in the types and concentrations of contaminants and variations in their flow paths may occur due to seasonal water table fluctuations, migration pathways, the passage of time, and other factors. Should additional analytical data become available in the future, these data should be reviewed and the conclusions and recommendations presented herein modified accordingly.

Chemical analyses have been performed for specific parameters during the course of this site review, as described in the text. Additional chemical contaminants not searched for during the current study may be present in soil and/or groundwater at the site.

Michigan's Miss Dig, private utility company owners (or designee) and/or property owners (or designee) were responsible for identifying the location of all utility lines and subterranean structures within the project area. CEC has requested responsible utilities and/or other appropriate public agencies to locate any utility lines known to exist within the public ROW. The drawings, within this report, reflect the locations of utilities and underground structures at the time of the investigation and, in all cases, should not be relied upon. In addition, the underground utility locations should only be used for presentation purposes and must be field verified.

CEC does not assume responsibility as generator for any wastes that may result as part of site remediation. All cost information contained in this report are estimates, which should be updated from time to time, and are based upon CEC's understanding of site conditions, the nature of the work to be completed, and the assumptions and conditions specified.

This report has been prepared for, and is intended for, the exclusive use of WESTON® and the Department of Management and Budget. The contents of this report should not be relied upon by any other party without the express written consent of CEC.

11.0 REFERENCES AND SOURCES

11.1 REFERENCES

ASTM Designation: E1943-98, *"Standard Guide for Remediation of Ground Water by Natural Attenuation at Petroleum Release Sites"*, American Society for Testing and Materials, August 1998, pgs. 3-14.

Davis, Mackenzie L., and David A. Cornwell, *"Introduction to Environmental Engineering"*, Michigan State University, PWS Engineering, 1985, pgs 201-220.

Drever, James I., *"The Geochemistry of Natural Waters"*, Prentice Hall, Second Edition, 1988, pgs 97-98.

Environmental Research and Technology, Inc, and Koppers Company, Inc., *"Handbook on Manufactured Gas Plant Sites"*, ERT Project No. P-D215, September 1984.

Mihelcic, James R., and Richard G. Luthy, *"Degradation of Polycyclic Aromatic Hydrocarbon Compounds under Various Redox Conditions in Soil-Water Systems"*, Department of Civil Engineering Carnegie Mellon University, Applied and Environmental Microbiology, May 1988, pgs. 1182-1187.

USEPA, *"Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA – Interim Final"*, October 1988, Publication Number EPA/540/G-89/004.

11.2 HISTORICAL DATA SOURCES

Sources of Evaluated Historical Data Presented Discussed in the Report and Presented on the Feasibility Study Figure Set:

1. Evaluated Historical Data – PGC Generated

Information evaluated was taken from the following sources:

- Summary tables provided by WESTON® as part of the CEC Work Plan, *"Florida Gas Peninsular Gas Company Facility and West Wetland Remedial Investigation and Feasibility Study Work Plan, Florida Location, Michigan, November 1999- Appendix B"*.
- Report Entitled *"Preliminary Hydrogeologic Investigation, Florida Location, Village of Laurium, Michigan, July 1993"* prepared for Peninsular Gas Company.
- October 1, 1999 Submittal to WESTON® on behalf of Peninsular Gas Company regarding the test pits conducted at the Plant Site with field notes, laboratory analytical, and photo documentation.

2. Evaluated Historical Data – MDEQ Generated

Information evaluated was taken from the following sources:

- The MDEQ/USEPA report entitled *"Draft Integrated Assessment Report for Florida Gas, Village of Laurium, Michigan, USEPA ID. NO. MI0002055150, June 21, 1999 DRAFT, Volume I".*

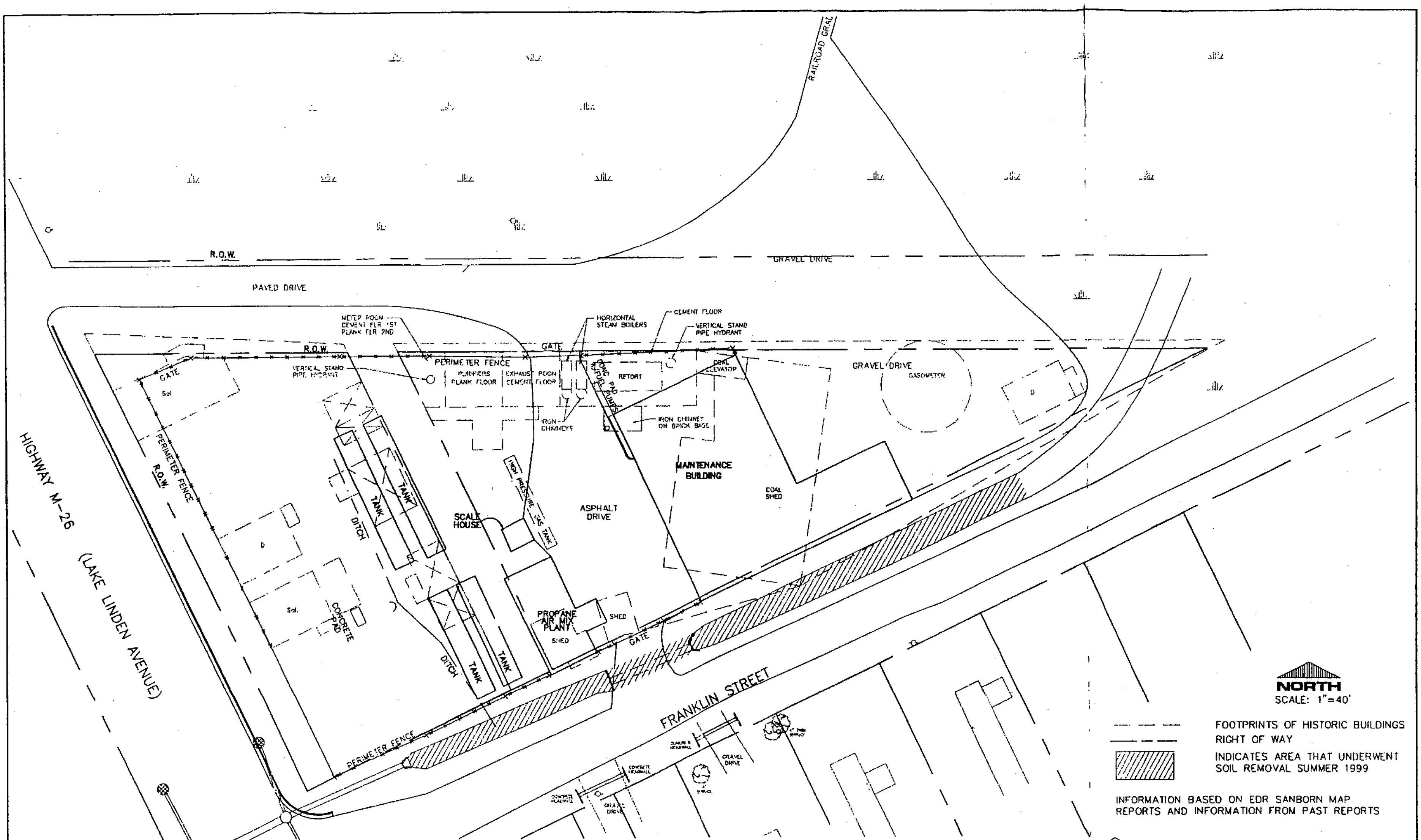
3. Evaluated Historical Data – CEC Generated

Information evaluated was compiled from the following source:

- The WESTON®/CEC prepared report entitled *"Florida Gas Drainage Ditch Remediation Report, Florida Location, Michigan, June 2000".*

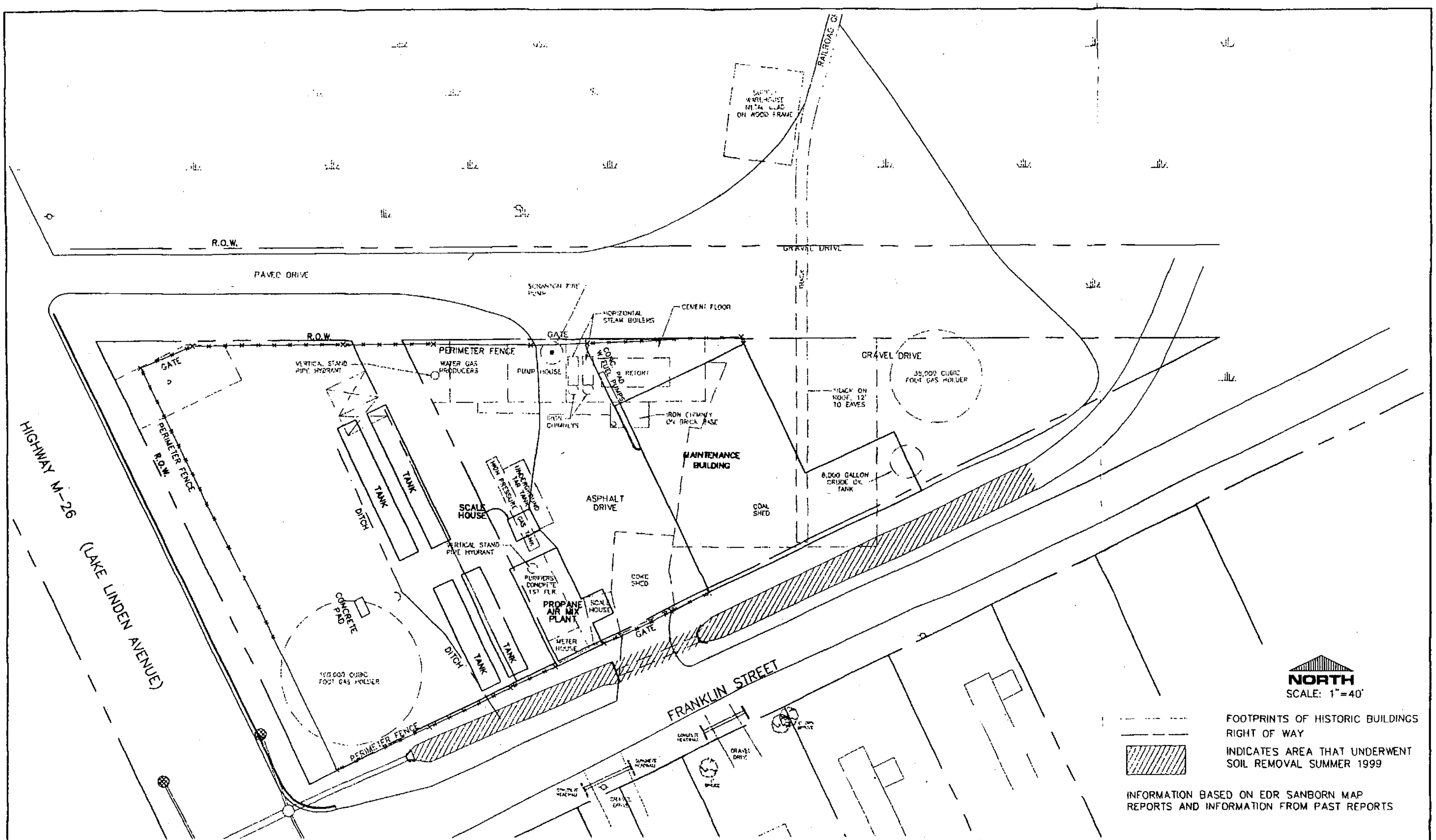
HLR/JTH/MAG/MLD

F:\Data\99000\99001\4 PLANT SITE\04 FINAL PLANT FS-REV1-03-01\Final FS-Plant Site-7-30-01.doc



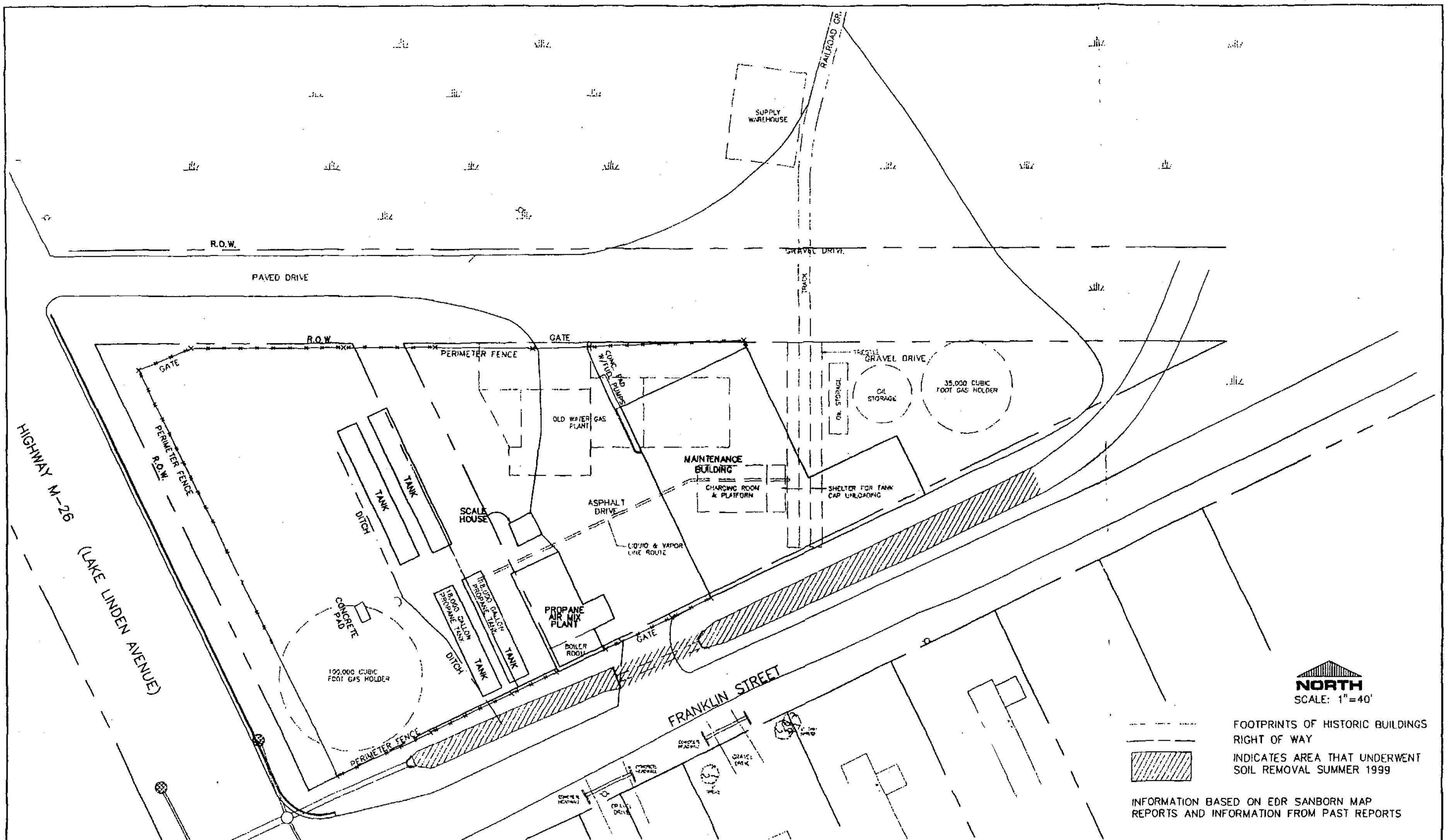
APPENDIX A-1 - SITE MAP SHOWING 1908 FEATURES
FLORIDA GAS-PLANT SITE
FLORIDA LOCATION, MICHIGAN

COLEMAN ENGINEERING COMPANY
635 CIRCLE DRIVE
IRON MOUNTAIN, MICHIGAN 49801
DATE 6/20/00
JOB NO 99001
CADD FILE 99001-F6-HISTORIC



APPENDIX A-2 – SITE MAP SHOWING 1917 FEATURES
FLORIDA GAS-PLANT SITE
FLORIDA LOCATION, MICHIGAN

COLEMAN ENGINEERING COMPANY
635 CIRCLE DRIVE
IRON MOUNTAIN, MICHIGAN 49801
DATE 6/20/00
JOB NO 99001
CADD FILE 99001-F6-HISTORIC



APPENDIX A-3 – SITE MAP SHOWING 1946 FEATURES
FLORIDA GAS-PLANT SITE
FLORIDA LOCATION, MICHIGAN

COLEMAN ENGINEERING COMPANY
635 CIRCLE DRIVE
IRON MOUNTAIN, MICHIGAN 49801

DATE 6/20/00
JOB NO 99001
CADD FILE 99001-F6-HISTORIC

Table 1
Preliminary Identification and Screening of Remedial Technologies and Process Options
Peninsular Gas Company - Plant Site Feasibility Study
Florida Gas Project
Florida Location, Michigan

Media	General Response Action	Remedial Technology	Process Options	Description	Applicability
Highly Contaminated Soils	No Action	No Action	No Action	No action will be taken at the site	No action should be considered as a potentially viable alternative.
	Institutional Controls	Access Restrictions	Zoning/Deed Restrictions	All deeds for property within potentially contaminated areas would include restrictions on use of property.	Potentially viable when combined with other options.
			Signs / Fencing	Signs and Fence would be installed around contaminated area.	Potentially viable when combined with other options.
	Monitoring/ Natural Attenuation	Monitoring/ Natural Attenuation	Monitoring/ Natural Attenuation	Using natural degradation, dispersion, and dilution for contaminant treatment and long-term monitoring of site conditions and contamination levels.	Potentially viable when combined with other options.
	Containment	Cap	Impermeable Cap	Engineered asphalt capping system truck traffic rated to promote runoff and minimize infiltration from above.	Potentially viable when combined with other options.
	In-situ Control/Treatment	Biological Treatment	Enhanced Biodegradation	Nutrients and oxygen are injected into the subsurface to promote biological degradation. Not very effective on coal tar waste.	Site is likely anaerobic in nature, efficiently converting to an aerobic condition would be difficult in the high cont. areas.
			Phytoremediation	Use of plant species to accumulate contaminants in their tissues. Species are harvested and disposed of.	Current land use does not allow for implementation. Overall effectiveness is high contaminated areas is limited.
		Chemical Treatment	Oxidation	Surface application of chemicals such as ozone, hydrogen peroxide, or permanganate for chemical oxidation of contaminants.	Potentially viable when combined with other options. (Possibly ORC in excavations).
			Reduction	Chemical injection to enhance and promote natural degradation already occurring.	Not efficient treatment option for VOCs and SVOCs.
		Physical Treatment	Soil Aeration	Aeration of soil via injection wells. Used to promote biodegradation. Also strips VOCs from the soil in conjunction with vapor extraction.	Not applicable for coal tar waste; no vadose zone really present.
			Soil Vapor Extraction	Removal of contaminants by application of a vacuum on soils through a network of wells.	Not applicable for coal tar waste; no vadose zone really present.
			Fixation	Soil mixed or injected with sorbent material which can fix contaminants and stabilize waste/soil mass.	Organic peat layer present already serves this role to some degree.
			Solvent Extraction	Application of solvent either via a surface flooding or injection and collection of extract at wells followed by treatment	Shallow watertable and nearby wetland and residential environment would make this very high risk.

Legend:
Alternative not carried forward.

Table 1 (continued)
Preliminary Identification and Screening of Remedial Technologies and Process Options
Peninsular Gas Company - Plant Site Feasibility Study
Florida Gas Project
Florida Location, Michigan

Media	General Response Action	Remedial Technology	Process Options	Description	Applicability
Highly Contaminated Soils	Limited Removal and Off-site Treatment	Excavate and Landfill	Off-site Landfill	Permanent storage of waste and contaminated soils at an approved landfill.	Potentially viable.
		Thermal Destruction	Off-site Incinerator	Thermal destruction of waste, contaminated soils, and liquids in an approved permitted incinerator.	Potentially viable.
		Biological Treatment	Land Farming	Waste and contaminated soil spread over land at a licensed land farm. Biological degradation occurs in aerated and nutrient rich soils.	Potentially viable
		Biological Treatment	Composting	Materials placed in controlled environment with addition of heat and air to aid degradation of contaminants.	Not viable. Amount of effort required vs. expected effectiveness makes option impractical.
	Limited Removal and On-site Treatment	Chemical Treatment	Oxidation	Oxidizer such as ozone, hydrogen peroxide, or permanganate is introduced into a contactor where it mixes with soil and oxidation occurs.	Not viable. Amount of effort required vs. expected effectiveness makes option impractical.
			Wet Air Oxidation	Oxidation of organics in a reactor under high pressure and temperature.	Not viable. Amount of effort required vs. expected effectiveness makes option impractical.
			Reduction	Reduction of organics.	Not applicable for coal tar waste.
			Solvent Extraction	Solvent is introduced into contactor where it mixes with solids. Extract is collected and later treated.	Not viable. Amount of effort required vs. expected effectiveness makes option impractical.
		Physical Treatment	Soil Washing	Use of water or steam to wash contaminants from soil.	Not viable. Amount of effort required vs. expected effectiveness makes option impractical.
			Solidification/ Stabilization	Solidification or stabilization of wastes using sulfide, lime, cement, molten glass, or various proprietary or patented products.	Potentially viable, would be required to reduce moisture content to make excavated material landfillable or subject to thermal destruction.
		Thermal Destruction	Pyrolysis	Solids are burned in an oxygen deficient atmosphere to produce char residue and VOC gases which are then incinerated.	Preliminary technology, no evidence present showing effectiveness on coal tar waste.
			Rotary Kiln	Solids are fed into a horizontally rotating cylinder designed for uniform heat transfer.	Potentially viable.
			Multiple Hearth	Solids are burned in a reactor consisting of a rotating central shaft and a series of flat hearths.	Potentially viable, although rotary kiln has been established in field.
			Fluidized Bed	Solids are added to a hot, agitated bed of sand where heat transfer and combustion occur.	Potentially viable, although rotary kiln has been established in field.
			Molten Salt	Solids are fed into a furnace with a molten salt bed acting as a catalyst and dispersing medium for incinerating wastes.	Preliminary technology, no evidence present showing effectiveness on coal tar waste.
			Infrared	Combustion of solids in a horizontal rectangular chamber using electric, infrared heat.	Preliminary technology, no evidence present showing effectiveness on coal tar waste.

Legend:

Alternative not carried forward

Table 1 (continued)
Preliminary Identification and Screening of Remedial Technologies and Process Options
Peninsular Gas Company - Plant Site Feasibility Study
Florida Gas Project
Florida Location, Michigan

Media	General Response Action	Remedial Technology	Process Options	Description	Applicability
Groundwater	No Action	No Action	No Action	No action will be taken at the site	No action must be considered as a potentially viable alternative
	Groundwater Use Restrictions	Groundwater Use Restrictions	Deed Restrictions	All deeds for property within potentially contaminated areas would include restrictions on use of property.	Potentially viable.
			Well Closure	Closure of drinking water wells and replacement as necessary within the affected area of influence.	Not applicable because no private wells are known to be contaminated.
	Monitoring/ Natural Attenuation	Monitoring/ Natural Attenuation	Monitoring/ Natural Attenuation	Using natural degradation, dispersion, and dilution for contaminant treatment and long-term monitoring of site conditions and contamination levels.	Potentially viable, although overall contaminant mass may not be reduced.
	Gradient Controls	Vertical Barriers	Slurry Wall	Trench is excavated while filled with a bentonite water slurry. Trench is backfilled with a soil-bentonite or cement bentonite mixture.	Not viable. Amount of effort required vs. expected effectiveness makes option impractical.
			Grout Curtain	Pressure injection of grout in a regular overlapping pattern of drilled holes.	Not viable. Amount of effort required vs. expected effectiveness makes option impractical.
			Sheet Piles	Driven steel sheet piling.	Not viable. Amount of effort required vs. expected effectiveness makes option impractical.
		Groundwater Diversion	Trenches	Trenches used to intercept and divert migration of contaminated groundwater around receptors.	Not viable. Amount of effort required vs. expected effectiveness makes option impractical.
			Drains	System of perforated pipe laid in trenches and backfilled with permeable media to intercept and divert contaminated groundwater.	Not viable. Amount of effort required vs. expected effectiveness makes option impractical.
	Extraction and Treatment	Extraction and Treatment	Trenches	Trenches used to intercept and collect contaminated groundwater.	Not viable. Amount of effort required vs. expected effectiveness makes option impractical.
			Drains	System of perforated pipe laid in trenches and backfilled with permeable media to intercept and collect contaminated groundwater.	Not viable. Amount of effort required vs. expected effectiveness makes option impractical.
			Extraction Wells	Wells installed to intercept and collect contaminated groundwater.	Potentially viable. May be required to maintain water levels within an area if sectioned off with a vertical barrier.
	In-situ Treatment	Biological Treatment	Bio Sparging	Injection of air to volatilize contaminants and raise dissolved oxygen levels to promote aerobic degradation.	Potentially viable. Could be used to address contaminated GW in the lower sand lens. Hardness, iron, and vapor migration may complicate.
			Enhanced Bioremediation	System of injection wells used to inject oxygen release compound, water, bacteria and/or nutrients to promote natural degradation.	Potentially viable. Could be used to address contaminated GW in the lower sand lens. Hardness, iron, and vapor migration may complicate.
		Physical/Chemical Treatment	Permeable Treatment Wall	Excavated or drilled areas filled with a treatment media that will remove or degrade contaminants in the groundwater as it passes through the treatment wall.	Not viable. Amount of effort required vs. expected effectiveness makes option impractical. Also signifinant negative wetland effects.
			Chemical Treatment	System of injection wells used to inject oxidizers such as ozone, permanganate, hydrogen peroxide, or oxygen release compound for degradation of organics.	Potentially viable. Could be used to address contaminated GW in the lower sand lens. Hardness, iron, and vapor migration may complicate.

Legend:
(dashed box) Alternative not carried forward

HLR/MAG/MLD
F:\data\99000\99001\DRAFT PLANT FS\tables\initialscreening-Plant-FS.xls
E-99001-F6

Table 2
Preliminary Evaluation of Remedial Technologies and Process Options
Peninsular Gas Company - Plant Site Feasibility Study
Florida Gas Project
Florida Location, Michigan

Media	General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability	Cost
Highly Contaminated Soils	No Action	No Action	No Action	May not achieve remedial action objectives.	Readily implementable.	None
	Access Restrictions	Access Restrictions	Zoning/Deed Restrictions	Effective for reducing direct contact, but does not reduce contaminant mass.	Readily implementable.	Low or No capital cost. Low O&M cost.
			Signs / Fencing	Effective for reducing direct contact of persons not using the Plant property, but does not limit DC to Plant workers, or reduce contaminant mass or mobility.	Readily implementable.	Low to moderate capital cost. Low to moderate O&M cost.
	Monitoring/ Natural Attenuation	Monitoring/ Natural Attenuation	Monitoring/ Natural Attenuation	Not effective for treatment of coal tar/oil highly contaminated soils.	Readily implementable.	Low or No capital cost. Moderate O&M cost for long term.
	Containment	Cap	Asphalt Type Cap	Effective for reducing direct contact, but does not reduce contaminant mass or potential migration.	Readily implementable. Requires installation of cover system.	Moderate capital cost. Low O&M cost for long term.
	In-situ Control/Treatment	Chemical Treatment	Oxidation	Could be effective for reducing contaminant mass and potential migration, if used as in conjunction with excavation of accessible highly contaminated areas.	Readily implementable likely cost prohibitive based on expected effectiveness.	Very High capital cost. No O&M cost.
	Limited Removal and Off-site Treatment	Excavate and Landfill	Off-site Landfill	Effective for reducing contaminant mass, direct contact, and migration potential.	Readily implementable.	High capital cost. No O&M cost .
		Thermal Destruction	Off-site Incinerator	Effective for reducing contaminant mass, direct contact, and migration potential.	Readily implementable. However, incinerator facilties are not nearby.	High capital cost. No O&M cost .
		Biological Treatment	Land Farming	Effective for reducing contaminant mass, direct contact, and migration potential.	Readily implementable. However, approvable land farming facilities are not nearby.	High capital cost. Low O&M cost.
	Limited Removal and On-site Treatment	Physical Treatment	Solidification/ Stabilization	Effective for helping to limit contaminant migration.	Could only be used in conjuction with other removal alternative to assist in treatment	Moderate to High capital cost. –
		Thermal Destruction	Rotary Kiln	Would be effective for reducing contaminant mass, direct contact, and migration potential, however prior analysis of this alternative indicates implementation impractical.	Soil types, water content, and engineering unknowns make this option impractical.	High capital cost. No O&M cost.

Legend:

Alternative not carried forward.

Notes:

1. Cost plays a limited role in the screening of process options at this stage. However, remedial technologies that are very expensive, but are equally or only marginally more effective than much lower cost technologies, are not preferred.

Table 2
Preliminary Evaluation of Remedial Technologies and Process Options
Peninsular Gas Company - Plant Site Feasibility Study
Florida Gas Project
Florida Location, Michigan

Media	General Response Action	Remedial Technology	Process Options	Effectiveness	Implementability	Cost
Groundwater	No Action	No Action	No Action	Does not achieve remedial action objectives.	Readily implementable.	None.
	Groundwater Use Restrictions	Groundwater Use Restrictions	Deed Restrictions	Does not meet objective for reducing contaminant mass.	Readily implementable.	Low capital cost. No O&M cost.
	Monitoring/ Natural Attenuation	Monitoring/ Natural Attenuation	Monitoring/ Natural Attenuation	Effective for contaminant treatment but may require a significant time frame.	Readily implementable.	Low or no capital cost. Moderate O&M cost for long term.
	Extraction and Treatment	Extraction and Treatment	Extraction Wells	Effective for limiting GW migration. However mass reduction in soil could produce similar results.	Readily implementable. Would require pilot testing.	Moderate to High capital cost. Moderate to High O&M cost.
	In-situ Treatment	Biological Treatment	Bio Sparging	May be effective in reducing gw contaminant migration by aerobically degrading contaminants.	Readily implementable. Would require pilot testing.	Moderate capital cost. Low to Moderate O&M cost.
			Enhanced Bioremediation	Would serve to enhance the effectiveness of a biological treatment system.	Readily implementable. Would require pilot testing.	Moderate capital cost. Low to Moderate O&M cost.
		Physical/Chemical Treatment	Chemical Treatment	More aggressive than biological treatment, effective in GW mass reduction, presents risk in vapor migration.	Readily implementable. More risk than biological treatment.	Moderate capital cost. Low to Moderate O&M cost.

Legend:

Alternative not carried forward

Table 3
Identification of Remedial Action Alternatives for Detailed Evaluation
Peninsular Gas Company - Plant Site Feasibility Study
Florida Gas Project
Florida Location, Michigan

Media	Alternative 1 No Action	Alternative 2 Institutional Controls	Alternative 3 Engineered Controls (Impermeable Cap)	Alternative 4 Limited Source Removal & Engineered Controls (Impermeable Cap)	Alternative 5 Limited Source Removal & Engineering Controls (Impermeable Cap & Groundwater Treatment)
Highly Contaminated Soils	No Action.	Zoning/Deed Restrictions with Signs and/or Fencing, and Environmental Monitoring.	Installation of an Asphalt Cover Cap, and Environmental Monitoring.	Limited Removal of Heavily Contaminated Soils and Installation of an Aphalt Cover Cap with Landfill Disposal and Environmental Monitoring	Limited Removal of Heavily Contaminated Soils and Installation of an Aphalt Cover Cap with Landfill Disposal, and Environmental Monitoring
Groundwater	No Action.	Groundwater Use Restrictions with Environmental Monitoring and Natural Attenuation.	Groundwater Use Restrictions with Environmental Monitoring and Natural Attenuation.	Groundwater Use Restrictions with Environmental Monitoring and Natural Attenuation.	Groundwater Use Restrictions with Enhanced Biological Treatment of Groundwater, Environmental Monitoring and Natural Attenuation.

HLR\MG\MLD
f:/data/99000/99001/DRAFT PLANT FS/fstables/idalternatives-PlantFS.xls
E-99001-F6

Table 4
Comparison of Potential Remedial Alternative
Penninsula Gas Company - Plant Site Feasibility Study
Florida Location, Michigan

ALTERNATIVE 2 - INSTITUTIONAL CONTROLS

EVALUATION CRITERIA	DESCRIPTION	Rating
I. TECHNICAL FEASIBILITY	TECHNICAL FEASIBILITY	
A. Long Term Effectiveness		
1. Degree that toxicity, mobility, and volume of contamination is expected to be reduced.	This alternative provides no active reduction of contaminant mass or mobility, except through natural attenuation. Under the current anaerobic conditions, the VOC/SVOC concentrations will decrease slowly, minimally reducing the contaminant mass.	1
2. Degree that remedial action option will protect human health, safety, welfare, and the environment.	Public health, safety, and welfare are protected by fencing/signs and deed/use restrictions. No protection is afforded PGC's workforce except for indoor air monitoring. Existing contaminants will continue to pose an environmental threat if not addressed by natural attenuation.	4
B. Short Term Effectiveness (Risk)	There are no short term adverse impacts on human health, safety and welfare except for the ones already existing. There are slight impacts on the environment and exposure risks to construction workers during fence installation.	7
C. Implementability		
1. Technical feasibility of construction and implementation.	Construction is not complicated and can be easily accomplished.	8
2. Availability of materials, equipment, technologies, and services	Contractors and materials are readily available.	9
3. Potential difficulties with construction or off-site disposal and treatment.	Underground utilities and structures are expected to cause some fence construction difficulties. No off-site disposal and treatment are required.	9
4. Difficulties with monitoring effectiveness.	Snow depths will create difficulties in completing environmental monitoring. Natural attenuation will be the most difficult portion of monitoring.	9
5. Administrative feasibility, including time needed to obtain permits and approvals.	MDEQ approval and community acceptance of this alternative may be difficult to obtain because no active remediation is planned. With no reduction in contaminat mass, toxicity or mobility deed/use restrictions may also be difficult ot obtain. Indoor air monitoring plan will need approval.	4
6. Ecological risk.	With no active remedial response measure being implemented, the ecological risks will continue to be similar to the ones already existing.	2
7. Technical feasibility of operation and maintenance.	Maintenance of fence and environmental monitoring wells/probes will not be difficult.	8
8. Technical feasibility of natural attenuation	Natural attenuation is occurring and this alternative relies on it heavily. However, the process is mainly anaerobic. The resulting slow degradation rate, causes contamation to persist in the enviroment and be a long term risk.	4
D. Restoration Time Frame	> 75 Years	
1. Estimated time to closure.	Estimated at 30 years	5
2. Acceptability of closure time frame	Low probability of acceptance due to the proximity to sensitive receptors (residences), the toxicity of the contamination, and the minimal reduction of contaminant mass and mobility through natural attenuation alone.	6
Technical Feasibility Rating Subtotal		76
II. ECONOMIC FEASIBILITY	ECONOMIC FEASIBILITY	
h		7
1. Capital costs.	$513,950	
2. Operation and Maintenance Present Worth Costs Over 30 Years.	$152,349	
3. Environmental Monitoring Present Worth Costs Over 30 Years.	$2,215,270	
4. Future Closure Present Worth Costs @ 30 Years	$8,320	
5 Total Present Worth	$2,889,889	
D. Future Liability Potential	Future liability is great since the magnitude and mobility of the contamination in either the soil or groundwater is not being reduced.	4
Economic Feasibility Rating Subtotal		11
III. TOTAL RATING		87

Note The rating system is from 1 to 10 with 10 as the highest score and 1 is the lowest.

MLD/HLR/MAG
f:\data\99000\99001\Plant Site FS\fstables\Alt Comparison Rating Tables xls
E-99001-F6

Table 4
Comparison of Potential Remedial Alternative
Peninsula Gas Company - Plant Site Feasibility Study
Florida Location, Michigan

ALTERNATIVE 4 - LIMITED SOURCE REMOVAL (LANDFILL) AND ENGINEERED CONTROLS (IMPERMEABLE COVER)

EVALUATION CRITERIA	DESCRIPTION	Rating
I. TECHNICAL FEASIBILITY	**TECHNICAL FEASIBILITY**	
A. Long Term Effectiveness		
1. Degree that toxicity, mobility, and volume of contamination is expected to be reduced.	Significant reduction in contaminant mass and toxicity occurs through the removal of the contaminateted soil. Remaining contamination is more likely to be addressed by natural attenuation. Contaminant mobility will be partially controlled by the impermeable cover.	6
2. Degree that remedial action option will protect human health, safety, welfare, and the environment.	Source reduction with impermeable cover provides the best overall protection of health, safety, and welfare of the public and PGC's workforce. Fencing/signs and deed/use restrictions will provide further protection. Remaining contaminants will continue to pose an environmental threat if not addressed by natural attenuation.	6
B. Short Term Effectiveness (Risk)	Short term public and environmental impacts caused by construction operations are expected but should not cause averse consequences. Unavoidable distruptions to PGC's operations will also occur. Exposure risks to construction workers and nearby residents will need to be monitored.	4
C. Implementability		
1. Technical feasibility of construction and implementation.	Excavation of contaminated soil can be completed if done cautiously. Asphalt paving is a commonly performed construction operation. Fence construction can be easily accomplished.	6
2. Availability of materials, equipment, technologies, and services.	Contractors and equipment are readily available. Properly trained personnel will be required.	6
3. Potential difficulties with construction or off-site disposal and treatment.	Underground utilities and structures and on-site buildings may cause construction difficulties. Hand tools will need to be used to in certian areas to prepare the asphalt cap subbase. Contaminated soil and excavation water will be transported off-site for disposal.	5
4. Difficulties with monitoring effectiveness.	Snow depths will create difficulties in completing environmental monitoring. Natural attenuation will be the most difficult portion of monitoring.	9
5. Administrative feasibility, including time needed to obtain permits and approvals.	MDEQ and community acceptance of this alternative should be attainable given the increased protection to the public and environment.	6
6. Ecological risk.	Ecological risks should be lessened by reducing the contaminant mass and installing the asphalt cap.	7
7. Technical feasibility of operation and maintenance.	Maintenance of the asphalt cap and environmental monitoring wells/probes will not be difficult	7
8. Technical feasibility of natural attenuation.	Remaining contaminant mass reduction relies on natural attenuation. Effectivness of natural attenuation is more likely with limited source removal of highly contaminated soil.	7
D. Restoration Time Frame	> 75 Years	
1. Estimated time to closure.	Estimated at 20 years	6
2. Acceptability of closure time frame.	Removal of the most highly contaminated soil reduces contaminant volume, toxicity and mobility which shortens the closure time period and makes this alternative acceptable..	8
Technical Feasibility Rating Subtotal		83
II. ECONOMIC FEASIBILITY	**ECONOMIC FEASIBILITY**	
A. Present Worth Analysis @ 6.875% Discount Rate.		5
1. Capital costs.	$2,462,145	
2. Operation & Maintenance Present Worth Costs Over 30 Years	$182,472	
3. Environmental Monitoring Present Worth Costs Over 30 Years	$1,796,199	
4. Future Closure Present Worth Costs @ 30 Years	$15,256	
5. Total Present Worth	$4,456,072	
D. Future Liability Potential	Future liability is reduced since direct contact exposure and mobility of contamination is being controlled. Some future liability still exists until remaining impacted materials are further reduced and the groundwater improves.	7
Economic Feasibility Rating Subtotal		12
III. TOTAL RATING		95

Note: The rating system is from 1 to 10 with 10 as the highest score and 1 is the lowest.

MLD/HLR/MAG
f:\data\99000\99001\Plant Site FS \fstables\Alt Comprison Rating Tables xls
E-99001-F6

Table 4
Comparison of Potential Remedial Alternative
Penninsula Gas Company - Plant Site Feasibility Study
Florida Location, Michigan

ALTERNATIVE 5 - LIMITED SOURCE REMOVAL (LANDFILL) AND GROUNDWATER TREATMENT (AIR SPARGING)

EVALUATION CRITERIA	DESCRIPTION	Rating
I. TECHNICAL FEASIBILITY	**TECHNICAL FEASIBILITY**	
A Long Term Effectiveness		
1 Degree that toxicity, mobility, and volume of contamination is expected to be reduced	Significant reduction in contaminant mass and toxicity occurs through the removal of the contaminateted soil. Remaining contamination is more likely to be addressed by natural attenuation. Contaminant mobility will be controlled by the impermeable cover and groundwater treatment system	7
2 Degree that remedial action option will protect human health, safety, welfare, and the environment	Source reduction with impermeable cover provides the best overall protection of health, safety, and welfare of the public and PGC's workforce. Fencing/signs and deed/use restrictions will provide further protection. Environmental threat from remaining contaminants will addressed by natural attenuation and grpundwater treatment	7
B Short Term Effectiveness (Risk)	Short term public and environmental impacts caused by construction operations are expected but should not cause avderse consequences. Unavoidable distruptions to PGC's operations will also occur. Exposure risks to construction workers and nearby residents will need to be monitored	4
C Implementability		
1 Technical feasibility of construction and implementation	Excavation of contaminated soil can be completed if done cautiously. Asphalt paving is a commonly performed construction operation. Fence construction can be easily accomplished. Success of groundwater treatment system may be technically limited by natural conditions which requires further evaluation with pilot testing before implementation	4
2 Availability of materials, equipment, technologies, and services	Contractors and equipment are readily available. Properly trained personnel will be required	4
3 Potential difficulties with construction or off-site disposal and treatment	Underground utilities and structures and on-site buildings may cause construction difficulties. Hand tools will need to be used to in certain areas to prepare the asphalt cap subbase. Contaminated soil and excavation water will be transported off-site for disposal	4
4 Difficulties with monitoring effectiveness	Snow depths will create difficulties in completing environmental monitoring. Natural attenuation of remaining materials will be the most difficult portion of monitoring	9
5 Administrative feasibility, including time needed to obtain permits and approvals	MDEQ and community acceptance of this alternative should be attainable given the increased protection to the public and environment.	6
6 Ecological risk.	Long term ecological risks will be lessened by reducing the contaminant mass, installing the asphalt capping and operating a groundwater treatment system	7
7 Technical feasibility of operation and maintenance	Maintenance of asphalt cap, environmental monitoring wells/probes and the treatment system equipment will not be difficult. Operation of the groundwater treatment system can be difficult and time consuming.	4
8 Technical feasibility of natural attenuation.	Remaining contaminanted soil mass reduction relies on natural attenuation. Effectivness of natural attenuation is more likely with limited source removal of highly contaminated soil	8
D Restoration Time Frame	> 75 Years	
1 Estimated time to closure.	Estimated at 20 years	6
2 Acceptability of closure time frame	Removal of the most highly contaminated materials reduces contaminant volume, toxicity, and mobility which greatly shortens the closure time period. The added benefit of groundwater treatment control measures to also lessen contaminant mobility makes this alternative the most acceptable	8
Technical Feasibility Rating Subtotal		78
II. ECONOMIC FEASIBILITY	**ECONOMIC FEASIBILITY**	
A Present Worth Analysis @ 6.875% Discount Rate		3
1 Capital costs	$2,761,695	
2 Operation & Maintenance Present Worth Costs Over 30 Years	$454,425	
3 Environmental Monitoring Present Worth Costs Over 30 Years	$2,143,024	
4 Future Closure Present Worth Costs @ 30 Years	$15,256	
5 Total Present Worth	$5,374,400	
D Future Liability Potential	Future liability is reduced since exposure to and mobility of contaminants is being controlled. Some future liability still exists until remaining impacted materials are further reduced and the groundwater improves.	8
Economic Feasibility Rating Subtotal		11
III. TOTAL RATING		89

Note The rating system is from 1 to 10 with 10 as the highest score and 1 is the lowest

MLD/HLR/MAG
f:\data\99000\99001\Plant Site FS \Tables\Alt Comparison Rating Tables xls
E-99001-F6

APPENDIX A – HISTORICAL SITE MAPS

Appendix A-1 – Site Map Showing 1908 Features and Evaluated Data Points
Appendix A-2 – Site Map Showing 1917 Features and Evaluated Data Points
Appendix A-3 – Site Map Showing 1946 Features and Evaluated Data Points

APPENDIX B – REMEDIAL ALTERNATIVE COST ESTIMATES

Alternative 2 - Institutional Controls
Remedial Alternative Cost Estimate
Peninsular Gas Company - Plant Site Feasibility Study
Florida Gas Project
Florida Location, Michigan

Item Number	Description	Quantity	Unit	Unit Price	Amount
I. CAPITAL COSTS					
ADMINISTRATIVE COSTS					
1	Project Administrative Costs	1	Lump Sum	$250,000	$250,000
	ADMINISTRATIVE SUBTOTAL				**$260,000**
CONSTRUCTION COSTS					
1	Mobilization and Project Administration	1	Lump Sum	$5,000	$5,000
2	Health and Safety Monitoring	1	Lump Sum	$5,000	$5,000
3	Traffic Control	1	Lump Sum	$1,000	$1,000
4	Decontamination	1	Lump Sum	$3,000	$3,000
5	Existing Fence & Gates Removal	1	Lump Sum	$2,500	$2,500
6	Chain Link Fence Clearing	1	Lump Sum	$500	$500
7	Chain Link Fence w/ Barbwire	1000	Linear Feet	$20	$20,000
8	Chain Link Fence Gates	5	Each	$1,500	$7,500
9	Site Restoration and Cleanup	1	Lump Sum	$2,500	$2,500
10	Groundwater Monitoring Wells	2	Each	$2,000	$4,000
11	Piezometer Monitoring Wells	4	Each	$3,000	$12,000
12	Indoor Air Monitoring Probes	16	Each	$1,250	$20,000
	CONSTRUCTION CONTINGENCY @ 15%				$12,450
	CONSTRUCTION SUBTOTAL				**$95,450**
ENGINEERING COSTS					
1	Project Management/Administration			$20,000	
2	Design, Specifications & Contract Documents			$10,000	
3	Permitting and Approvals			$2,500	
4	Deed / Use Restrictions and Property Access			$30,000	
5	Secure Contractor			$2,500	
6	Design & Construction Surveying			$5,000	
7	Construction Observation and Contract Administration			$10,000	
8	Construction Update Progress Reports			$2,500	
9	Construction Documentation Report			$7,500	
10	Health and Safety Plan			$2,500	
11	Environmental Monitoring Plan			$15,000	
12	Stormwater Pollution Prevention Plan			$5,000	
13	Indoor Air Monitoring Plan			$7,500	
14	Groundwater/Piezometer Monitoring Well Installation w/ Soil Sampling and Lab			$16,000	
15	Indoor Air Monitoring Probe Installation w/ Soil Sampling and Lab			$27,500	
16	Public Involvement Process			$5,000	
	ENGINEERING SUBTOTAL				**$168,500**
	TOTAL CAPITAL COST				**$613,960**
II. ANNUAL OPERATION AND MAINTENANCE UNIT COST ASSUMPTIONS					
1	Fence Maintenance @ 5 Year Intervals	1,000	Linear Feet	$5	$5,000
2	Fence Maintenance Engineering @ 5 Year Intervals	1	Lump Sum	$2,500	$2,500
3	Fence Replacement Construction @ 20 Year Intervals	1	Lump Sum	$35,000	$35,000
4	Fence Replacement Engineering @ 20 Year Intervals	1	Lump Sum	$15,000	$15,000
5	Groundwater/Piezometer/Air Probe Maint. @ 5 Year Intervals	47	Each	$250	$11,750
6	Groundwater/Piezometer/Air Probe Maint. Eng. @ 5 Year Intervals	1	Lump Sum	$3,000	$3,000
7	Building Vapor Proofing Maintenance @ 5 Year Intervals	1	Lump Sum	$4,000	$4,000
8	Building Vapor Proofing Maintenance Engineering @ 5 Year Intervals	1	Lump Sum	$2,500	$2,500
9	Annual Report	1	Lump Sum	$5,000	$5,000

Alternative 2 - Institutional Controls
Remedial Alternative Cost Estimate
Peninsular Gas Company - Plant Site Feasibility Study
Florida Gas Project
Florida Location, Michigan

Item Number	Description	Quantity	Unit	Unit Price	Amount
III.	**ENVIRONMENTAL MONITORING UNIT COST ASSUMPTIONS**				
1	Groundwater/Piezometer Monitoring Well Sampling Per Event			$45,000	
2	Groundwater Monitoring Laboratory Per Event			$33,000	
3	Surface Water Monitoring Sampling Per Event			$2,000	
4	Surface Water Monitoring Laboratory Per Event			$3,000	
5	Soil Monitoring Sampling Per Event			$10,000	
6	Soil Monitoring Laboratory Per Event			$8,500	
7	Indoor Air Monitoring Sampling Per Event			$6,000	
8	Indoor Air Monitoring Laboratory Per Event			$5,000	
9	Storm Water Run-off Monitoring Sampling Per Event			$2,000	
10	Storm Water Run-off Monitoring Laboratory Per Event			$3,500	
11	Analytical Data Review @ 5 Year Intervals			$5,000	
IV.	**FUTURE CLOSURE COST ASSUMPTIONS**				
1	Closure Risk Assessment @ 30 Years			$25,000	
2	Closure Request @ 30 Years			$25,000	
V.	**PRESENT WORTH ANALYSIS (6.875% DISCOUNT RATE)**				
	TOTAL CAPITAL COSTS				**$513,950**
1	Fence Maintenance @ 5 Year Intervals Over 30 Years			$18,030	
2	Fence Replacement Costs @ 20 Years			$15,256	
3	Groundwater/Piezeometer/Air Probe Maint. @ 5 Year Intverals Over 30 Years			$35,459	
4	Building Vapor Proofing Maintenance @ 5 Year Intervals Over 30 Years			$15,626	
5	Annual Reports Over 30 Years			$67,978	
	TOTAL OPERATION AND MAINTENANCE COSTS				**$152,349**
1	Groundwater Monitoring Well Sampling Over 30 Years			$1,673,354	
2	Surface Water Monitoring Sampling Over 30 Years			$107,266	
3	Soil Monitoring Sampling @ 10 Year Intervals Over 30 Years			$18,938	
4	Indoor Air Monitoring Sampling Over 30 Years			$328,917	
5	Stormwater Run-off Sampling for 30 Years			$74,775	
6	Analytical Data Review @ 5 Year Intervals Over 30 Years			$12,020	
	TOTAL ENVIRONMENTAL MONITORING COSTS				**$2,216,270**
1	Closure Risk Assessment @ 30 Years			$4,160	
2	Closure Request @ 30 Years			$4,160	
	TOTAL FUTURE COSTS				**$8,320**
	TOTAL PRESENT WORTH				**$2,889,889**

Note: Groundwater (31 Wells) and surface water (3 Locations) sampling would occur on a quarterly basis for the first 2 years, semi-annually for the next 3 years, and annually thereafter for 30 years. Air monitoring would occur monthly for the first year and then on the same schedule as groundwater and surface water sampling. Soil sampling (10 Locations) would occur every 10 years for 30 years. Stormwater run-off (4 Locations) monitoring would occur 4 times a year for 30 years.

Alternative 3 - Engineered Controls (Impermeable Cover)
Remedial Alternative Cost Estimate
Peninsular Gas Company - Plant Site Feasibility Study
Florida Gas Project
Florida Location, Michigan

Item Number	Description	Quantity	Unit	Unit Price	Amount
I.	CAPITAL COSTS				
	ADMINISTRATIVE COSTS				
1	Project Administrative Costs	1	Lump Sum	$250,000	$250,000
	ADMINISTRATIVE SUBTOTAL				$250,000
	CONSTRUCTION COSTS				
	General				
1	Mobilization and Project Administration	1	Lump Sum	$20,000	$20,000
2	Health and Safety Monitoring	1	Lump Sum	$15,000	$15,000
3	Air Monitoring	1	Lump Sum	$15,000	$15,000
4	Traffic Control	1	Lump Sum	$5,000	$5,000
5	Decontamination	1	Lump Sum	$7,500	$7,500
6	Silt Fence	1,000	Linear Feet	$2	$2,000
7	Hay Bales	20	Each	$12	$240
8	Site Restoration and Cleanup	1	Lump Sum	$5,000	$5,000
	Fencing	-	-	-	-
9	Existing Fence & Gates Removal	1	Lump Sum	$2,500	$2,500
10	Chain Link Fence Clearing	1	Lump Sum	$500	$500
11	Chain Link Fence w/ Barbwire	1000	Linear Feet	$20	$20,000
12	Chain Link Fence Gates	5	Each	$1,500	$7,500
	Asphalt Cap	-	-	-	-
13	Existing Asphalt Removal	1650	Sq. Yard	$4	$6,600
14	Subgrade Undercut - Machine Removal	3600	Cubic Yard	$12	$43,200
15	Subgrade Undercut - Hand Removal	800	Cubic Yard	$40	$32,000
16	Transportation and Diposal of Non-Impacted Materials	1700	Tons	$10	$17,000
17	Transportation to and Disposal of Impacted Materials at Landfill	5300	Tons	$45	$238,500
18	Surface Water Diversion	1	Lump Sum	$3,000	$3,000
18	MDOT Class II Granular Fill (12" thick Compacted-in-Place(CIP))	7100	Sq. Yard	$4	$28,400
19	MDOT 22A Aggregate Base (8' thick CIP)	7000	Sq. Yard	$5	$35,000
20	Bituminous Pavement (4" thick)	1,600	Tons	$65	$104,000
21	MDOT 23A Shoulder (4" thick CIP)	250	Sq. Yard	$5	$1,250
22	Semi-truck Concrete Off Loading Pad	200	Sq. Yard	$50	$10,000
	Railroad Grade Culvert	-	-	-	-
24	Railroad Grade Culvert (36" Diameter)	50	Linear Feet	$60	$3,000
25	Railroad Grade Apron Endwall Installation (36"Diameter)	2	Each	$1,500	$3,000
23	Riprap Delivered and Placed	250	Sq. Yard	$10	$2,500
	Monitoring Points	-	-	-	-
26	Groundwater Monitoring Wells	2	Each	$2,000	$4,000
27	Piezometer Monitoring Wells	4	Each	$3,000	$12,000
28	Indoor Air Monitoring Probes	16	Each	$1,250	$20,000
	CONSTRUCTION CONTINGENCY @ 15%				$99,554
	CONSTRUCTION SUBTOTAL				$763,244

Alternative 3 - Engineered Controls (Impermeable Cover)
Remedial Alternative Cost Estimate
Peninsular Gas Company - Plant Site Feasibility Study
Florida Gas Project
Florida Location, Michigan

Item Number	Description	Quantity	Unit	Unit Price	Amount
I. CAPITAL COSTS (Continued)					
ENGINEERING COSTS					
1	Project Management/Administration			$25,000	
2	Design, Specifications & Contract Documents			$15,000	
3	Permitting and Approvals			$7,500	
4	Deed / Use Restrictions and Property Access			$30,000	
5	Secure Contractor			$7,500	
8	Design & Construction Surveying			$7,500	
6	Construction Observation and Contract Administration			$60,000	
15	Construction Update Progress Reports			$7,500	
7	Construction Documentation Report			$15,000	
9	Health and Safety Plan			$5,000	
10	Environmental Monitoring Plan			$15,000	
11	Stormwater Pollution Prevention Plan			$5,000	
12	Indoor Air Monitoring Plan			$7,500	
13	Groundwater/Piezometer Monitoring Well Installation w/ Soil Sampling and Lab			$16,000	
14	Indoor Air Monitoring Probe Installation w/ Soil Sampling and Lab			$27,500	
16	Public Involvement Process			$10,000	
	ENGINEERING SUBTOTAL				**$261,000**
	TOTAL CAPITAL COSTS				**$1,274,244**
II. ANNUAL OPERATION AND MAINTENANCE UNIT COST ASSUMPTIONS					
1	Fence Maintenance @ 5 Year Intervals	1,000	Linear Feet	$5	$5,000
2	Fence Maintenance Engineering @ 5 Year Intervals	1	Lump Sum	$2,500	$2,500
3	Fence Replacement Construction @ 20 Year Intervals	1	Lump Sum	$35,000	$35,000
4	Fence Replacement Engineering @ 20 Year Intervals	1	Lump Sum	$15,000	$15,000
5	Groundwater/Piezometer/Air Probe Maint. @ 5 Year Intervals	47	Each	$250	$11,750
6	Groundwater/Piezometer/Air Probe Maint. Eng. @ 5 Year Intervals	1	Lump Sum	$3,000	$3,000
7	Building Vapor Proofing Maintenance @ 5 Year Intervals	1	Lump Sum	$4,000	$4,000
8	Building Vapor Proofing Maintenance Engineering @ 5 Year Intervals	1	Lump Sum	$2,500	$2,500
9	Annual Asphalt Cap Maintenance	1	Lump Sum	$1,500	$1,500
10	Annual Asphalt Cap Maintenance Engineering	1	Lump Sum	$1,000	$1,000
11	Asphalt Cap Sealing @ 5 Year Intervals	1	Lump Sum	$4,000	$4,000
12	Asphalt Cap Sealing Engineering @ 5 Year Intervals	1	Lump Sum	$2,500	$2,500
13	Annual Reports	1	Lump Sum	$7,500	$7,500
III. ENVIRONMENTAL MONITORING UNIT COST ASSUMPTIONS					
1	Groundwater/Piezometer Monitoring Well Sampling Per Event			$45,000	
2	Groundwater Monitoring Laboratory Per Event			$33,000	
3	Surface Water Monitoring Sampling Per Event			$2,000	
4	Surface Water Monitoring Laboratory Per Event			$3,000	
5	Soil Monitoring Sampling Per Event			$10,000	
6	Soil Monitoring Laboratory Per Event			$8,500	
7	Indoor Air Monitoring Sampling Per Event			$6,000	
8	Indoor Air Monitoring Laboratory Per Event			$5,000	
9	Analytical Data Review @ 5 Year Intervals			$5,000	

Alternative 3 - Engineered Controls (Impermeable Cover)
Remedial Alternative Cost Estimate
Peninsular Gas Company - Plant Site Feasibility Study
Florida Gas Project
Florida Location, Michigan

Item Number	Description	Quantity	Unit	Unit Price	Amount
IV.	**FUTURE CLOSURE COST ASSUMPTIONS**				
1	Closure Risk Assessment @ 30 Years			$25,000	
2	Closure Request @ 30 Years			$25,000	
V.	**PRESENT WORTH ANALYSIS (6.875% DISCOUNT RATE)**				
	TOTAL CAPITAL COSTS				**$1,274,244**
1	Fence Maintenance @ 5 Year Intervals Over 30 Years			$18,030	
2	Fence Replacement Costs @ 20 Years			$15,256	
3	Groundwater/Piezeometer Well Maint. @ 5 Year Intervals Over 30 Years			$35,459	
4	Building Vapor Proofing Maintenance @ 5 Year Intervals Over 30 Years			$15,626	
5	Annual Asphalt Cap Maintenance Over 30 Years			$33,989	
6	Asphalt Cap Sealing @ 5 Year Intervals Over 30 Years			$15,626	
7	Annual Reports Over 30 Years			$101,966	
	TOTAL OPERATION AND MAINTENANCE COSTS				**$235,953**
1	Groundwater Monitoring Well Sampling Over 30 Years			$1,673,354	
2	Surface Water Monitoring Sampling Over 30 Years			$107,266	
3	Soil Monitoring Sampling @ 10 Year Intervals Over 30 Years			$18,938	
4	Indoor Air Monitoring Sampling Over 30 Years			$328,917	
5	Analytical Data Review @ 5 Year Intervals Over 30 Years			$12,020	
	TOTAL ENVIRONMENTAL MONITORING COSTS				**$2,140,495**
1	Closure Risk Assessment @ 30 Years			$4,160	
2	Closure Request @ 30 Years			$4,160	
	TOTAL FUTURE COSTS				**$8,320**
	TOTAL PRESENT WORTH				**$3,659,011**

Note: Groundwater (31 Wells) and surface water (3 Locations) sampling would occur on a quarterly basis for the first 2 years, semi-annually for the next 3 years, and annually thereafter for 30 years. Air monitoring would occur monthly for the first year and then on the same schedule as groundwater and surface water sampling. Soil sampling (10 Locations) would occur every 10 years for 30 years

Alternative 4 - Limited Source Removal (Landfill)
Remedial Alternative Cost Estimate
Peninsular Gas Compnay - Plant Site Feasibility Study
Florida Gas Project
Florida Location, Michigan

Item Number	Description	Quantity	Unit	Unit Price	Amount
I.	**CAPITAL COSTS**				
	ADMINISTRATIVE COSTS				
1	Project Administrative Costs	1	Lump Sum	$250,000	$250,000
	ADMINISTRATIVE SUBTOTAL				$250,000
	CONSTRUCTION COSTS				
	General				
1	Mobilization and Job Administration	1	Lump Sum	$50,000	$50,000
2	Health and Safety Monitoring	1	Lump Sum	$25,000	$25,000
3	Air Monitoring	1	Lump Sum	$25,000	$25,000
4	Traffic Control	1	Lump Sum	$10,000	$10,000
5	Decontamination	1	Lump Sum	$15,000	$15,000
6	Silt Fence	1,000	Linear Feet	$2	$2,000
7	Hay Bales	20	Each	$12	$240
8	Site Restoration and Cleanup	1	Lump Sum	$10,000	$10,000
	Fencing	--	--	--	--
9	Existing Fence & Gates Removal	1	Lump Sum	$2,500	$2,500
10	Chain Link Fence Clearing	1	Lump Sum	$500	$500
11	Chain Link Fence w/ Barbwire	1000	Linear Feet	$20	$20,000
12	Chain Link Fence Gates	5	Each	$1,500	$7,500
	Limited Removal	--	--	--	--
13	M-26 Concrete Pavement Removal	200	Sq. Yard	$12	$2,400
14	M-26 Concrete Curb & Gutter Removal	70	Linear Feet	$8	$560
15	Existing Asphalt Removal	1650	Sq. Yard	$4	$6,600
16	Excavation	14800	Tons	$8	$118,400
17	Transportation and Diposal of Non-Impacted Materials	1700	Tons	$10	$17,000
18	Transportation to and Disposal of Impacted Materials at Landfill	14,800	Tons	$45	$666,000
19	Scale House Demolition /Replacement	1	Lump Sum	$10,000	$10,000
20	Stormwater Diversion	1	Lump Sum	$8,000	$8,000
21	Excavation and Decon Water Collection, Treatment and Disposal	30,000	Gallon	$0.25	$7,500
22	Clean Engineered Earth Backfill (Compacted-in-Place (CIP))	14,800	Tons	$8	$118,400
23	M-26 Culvert Replacement (36" Diameter, Concrete)	200	Lump Sum	$60	$12,000
24	M-26 Manhole Inlet Structures (6' Diameter, Concrete)	2	Each	$2,500	$5,000
25	M-26 Culvert Apron Endwall (36" Diameter)	2	Each	$1,500	$3,000
26	M-26 Storm Sewer	3	Each	$500	$1,500
27	M-26 Curb and Gutter	70	Linear Feet	$35	$2,450
28	M-26 Concrete Pavewment	200	Linear Feet	$50	$10,000
29	Semi-truck Concrete Off Loading Pad (Concrete)	200	Sq. Yard	$50	$10,000
	Asphalt Cap	--	--	--	--
30	Subgrade Undercut - Machine Removal	1800	Cubic Yard	$12	$21,600
31	Subgrade Undercut - Hand Removal	800	Cubic Yard	$40	$32,000
32	MDOT Class II Granular Fill (12" thick CIP)	7100	Sq. Yard	$4	$28,400
33	MDOT 22A Aggregate Base (8' thick CIP)	7000	Sq. Yard	$5	$35,000
34	Bituminous Pavement (4" thick)	1,600	Tons	$65	$104,000
35	MDOT 23A Shoulder (4" thick CIP)	250	Sq. Yard	$5	$1,250
	Railroad Grade Culvert				
36	Railroad Grade Culvert (36" Diameter)	50	Linear Feet	$60	$3,000
37	Railroad Grade Apron Endwall (36"Diameter)	2	Each	$1,500	$3,000
38	Riprap Delivered and Placed	1,750	Sq. Yard	$10	$17,500

Alternative 4 - Limited Source Removal (Landfill)
Remedial Alternative Cost Estimate
Peninsular Gas Compnay - Plant Site Feasibility Study
Florida Gas Project
Florida Location, Michigan

Item Number	Description	Quantity	Unit	Unit Price	Amount
I.	**CAPITAL COSTS (Continued)**				
	CONSTRUCTION COSTS (Continued)				
	Monitoring Points	--	--	--	--
39	Well Abandonment	11	Each	$1,000	$11,000
40	Groundwater Monitoring Wells	6	Each	$2,000	$12,000
41	Piezometer Monitoring Wells	7	Each	$3,000	$21,000
42	Indoor Air Monitoring Probes	16	Each	$1,250	$20,000
43	Remedial Alternative Verification Sampling Borings	6	Each	$1,000	$6,000
	CONSTRUCTION CONTINGENCY @ 15%				$222,345
	CONSTRUCTION SUBTOTAL				**$1,704,645**
	ENGINEERING COSTS				
1	Project Management/Administration			$35,000	
2	Design, Specifications & Contract Documents			$20,000	
3	Permitting and Approvals			$15,000	
4	Deed / Use Restrictions and Property Access			$30,000	
5	Secure Contractors			$7,500	
6	Design & Construction Surveying			$15,000	
7	Construction Observation and Contract Administration			$160,000	
8	Construction Update Progress Reports			$10,000	
9	Construction Documentation Report			$35,000	
10	Health and Safety Plan			$5,000	
11	Environmental Monitoring Plan			$15,000	
12	Stormwater Pollution Prevention Plan			$5,000	
13	Indoor Air Monitoring Plan			$7,500	
14	Groundwater/Piezometer Monitoring Well Installation w/ Soil Sampling and Lab			$32,000	
15	Indoor Air Monitoring Probe Installation w/ Soil Sampling and Lab			$27,500	
16	Public Involvement Process			$10,000	
17	Remedial Alternative Verification Sampling and Lab			$20,000	
18	Confirmation VSR Sampling Lab			$58,000	
	ENGINEERING SUBTOTAL				**$507,500**
	TOTAL CAPITAL COSTS				**$2,462,145**
II.	**ANNUAL OPERATION AND MAINTENANCE UNIT COST ASSUMPTIONS**				
1	Fence Maintenance @ 5 Year Intervals	1,000	Linear Feet	$5	$5,000
2	Fence Maintenance Engineering @ 5 Year Intervals	1	Lump Sum	$2,500	$2,500
3	Groundwater/Piezometer/Air Probe Maint. @ 5 Year Intervals	43	Each	$250	$10,750
4	Groundwater/Piezometer/Air Probe Maint. Eng. @ 5 Year Intervals	1	Lump Sum	$3,000	$3,000
5	Building Vapor Proofing Maintenance @ 5 Year Intervals	1	Lump Sum	$4,000	$4,000
6	Building Vapor Proofing Maintenance Engineering @ 5 Year Intervals	1	Lump Sum	$2,500	$2,500
7	Annual Asphalt Cap Maintenance	1	Lump Sum	$1,500	$1,500
8	Annual Asphalt Cap Maintenance Engineering	1	Lump Sum	$1,000	$1,000
9	Asphalt Cap Sealing @ 5 Year Intervals	1	Lump Sum	$4,000	$4,000
10	Asphalt Cap Sealing Engineering @ 5 Year Intervals	1	Lump Sum	$2,500	$2,500
11	Annual Report	1	Lump Sum	$7,500	$7,500

Alternative 4 - Limited Source Removal (Landfill)
Remedial Alternative Cost Estimate
Peninsular Gas Compnay - Plant Site Feasibility Study
Florida Gas Project
Florida Location, Michigan

Item Number	Description	Quantity	Unit	Unit Price	Amount
III. ENVIRONMENTAL MONITORING UNIT COST ASSUMPTIONS					
1	Groundwater/Piezometer Monitoring Well Sampling Per Event			$40,000	
2	Groundwater Monitoring Laboratory Per Event			$30,000	
3	Surface Water Monitoring Sampling Per Event			$2,000	
4	Surface Water Monitoring Laboratory Per Event			$3,000	
5	Soil Monitoring Sampling Per Event			$10,000	
6	Soil Monitoring Laboratory Per Event			$8,500	
7	Indoor Air Monitoring Sampling Per Event			$6,000	
8	Indoor Air Monitoring Laboratory Per Event			$5,000	
9	Analytical Data Review @ 5 Year Intervals			$5,000	
IV. FUTURE CLOSURE COST ASSUMPTIONS					
1	Closure Risk Assessment @ 20 Years			$25,000	
2	Closure Request @ 20 Years			$25,000	
V. PRESENT WORTH ANALYSIS (6.875% DISCOUNT RATE)					
	TOTAL CAPITAL COSTS				**$2,462,145**
1	Fence Maintenance @ 5 Year Intervals Over 20 Years			$15,080	
2	Groundwater/Piezeometer/Air Probe Maint. @ 5 Year Intervals Over 20 Years			$27,647	
3	Building Vapor Proofing Maintenance @ 5 Year Intervals Over 20 Years			$13,070	
4	Annual Asphalt Cap Maintenance Over 20 Years			$28,401	
5	Asphalt Cap Sealing @ 5 Year Intervals Over 20 Years			$13,070	
6	Annual Reports Over 20 Years			$85,204	
	TOTAL OPERATION AND MAINTENANCE COSTS				**$182,472**
1	Groundwater Monitoring Well Sampling Over 20 Years			$1,345,278	
2	Surface Water Monitoring Sampling Over 20 Years			$96,091	
3	Soil Monitoring Sampling @ 10 Year Intervals Over 20 Years			$15,859	
4	Indoor Air Monitoring Sampling Over 20 Years			$328,917	
5	Analytical Data Review @ 5 Year Intervals Over 20 Years			$10,054	
	TOTAL ENVIRONMENTAL MONITORING COSTS				**$1,796,199**
1	Closure Risk Assessment @ 20 Years			$7,628	
2	Closure Request @ 20 Years			$7,628	
	TOTAL FUTURE COSTS				**$15,256**
	TOTAL PRESENT WORTH				**$4,456,072**

Note: Groundwater (27 Wells) and surface water (3 Locations) sampling would occur on a quarterly basis for the first 2 years, semi-annually for the next 3 years, and annually thereafter for 20 years. Air monitoring would occur monthly for the first year and then on the same schedule as groundwater and surface water sampling. Soil sampling (10 Locations) would occur every 10 years for 20 years

Alternative 5 - Limited Source Removal (Landfill) and Groundwater Treatment (Air Sparging)
Remedial Alternative Cost Estimate
Peninsular Gas Company - Plant Site Feasibility Study
Florida Gas Project
Florida Location, Michigan

Item Number	Description	Quantity	Unit	Unit Price	Amount
I. CAPITAL COSTS					
	ADMINISTRATIVE COSTS				
1	Project Administrative Costs	1	Lump Sum	$250,000	$250,000
	ADMINISTRATIVE SUBTOTAL				*$250,000*
	CONSTRUCTION COSTS				
General					
1	Mobilization and Job Administration	1	Lump Sum	$50,000	$50,000
2	Health and Safety Monitoring	1	Lump Sum	$25,000	$25,000
3	Air Monitoring	1	Lump Sum	$25,000	$25,000
4	Traffic Control	1	Lump Sum	$10,000	$10,000
5	Decontamination	1	Lump Sum	$15,000	$15,000
6	Silt Fence	1,000	Linear Feet	$2	$2,000
7	Hay Bales	20	Each	$12	$240
8	Site Restoration and Cleanup	1	Lump Sum	$10,000	$10,000
Fencing		-	-	-	-
9	Existing Fence & Gates Removal	1	Lump Sum	$2,500	$2,500
10	Chain Link Fence Clearing	1	Lump Sum	$500	$500
11	Chain Link Fence w/ Barbwire	1000	Linear Feet	$20	$20,000
12	Chain Link Fence Gates	5	Each	$1,500	$7,500
Limited Removal		-	-	-	-
13	M-26 Concrete Pavement Removal	200	Sq. Yard	$12	$2,400
14	M-26 Concrete Curb & Gutter Removal	70	Linear Feet	$8	$560
15	Existing Asphalt Removal	1650	Sq. Yard	$4	$6,600
16	Excavation	14,800	Tons	$8	$118,400
18	Transportation and Diposal of Non-Impacted Materials	1700	Tons	$10	$17,000
19	Transportation to and Disposal of Impacted Materials at Landfill	14,800	Tons	$45	$666,000
20	Scale House Demolition and Replacement	1	Lump Sum	$10,000	$10,000
21	Stormwater Diversion	1	Lump Sum	$8,000	$8,000
22	Excavation and Decon Water Collection, Treatment and Disposal	30,000	Gallon	$0.25	$7,500
23	Clean Engineered Earth Backfill (Compacted-in-Place (CIP))	14,800	Tons	$8	$118,400
24	M-26 Culvert Replacement (36" Diameter, Concrete)	200	Lump Sum	$60	$12,000
25	M-26 Manhole Inlet Structure (6' Diamater, Concrete)	2	Each	$2,500	$5,000
26	M-26 Culvert Apron Endwall (36" Diameter)	2	Each	$1,500	$3,000
27	M-26 Storm Sewer	3	Each	$500	$1,500
28	M-26 Curb and Gutter	70	Linear Feet	$35	$2,450
29	M-26 Concrete Pavement	200	Linear Feet	$50	$10,000
30	Semi-truck Concrete Off Loading Pad	200	Sq. Yard	$50	$10,000
Asphalt Cap		-	-	-	-
17	Subgrade Undercut - Machine Removal	1800	Cubic Yard	$12	$21,600
17	Subgrade Undercut - Hand Removal	800	Cubic Yard	$40	$32,000
31	MDOT Class II Granular Fill (12" thick CIP)	7100	Sq. Yard	$4	$28,400
32	MDOT 22A Aggregate Base (8" thick CIP)	7000	Sq. Yard	$5	$35,000
33	Bituminous Pavement (4" thick)	1,600	Tons	$65	$104,000
34	MDOT 23A Shoulder (4" thick CIP)	250	Sq. Yard	$5	$1,250
Railroad Grade Culvert					
35	Railroad Grade Culvert (36" Diameter)	50	Linear Feet	$60	$3,000
36	Railroad Grade Apron Endwall (36"Diameter)	2	Each	$1,500	$3,000
37	Riprap Delivered and Placed	1,750	Sq Yard	$10	$17,500
Groundwater Treatment System		-	-	-	-
38	Air Sparge Points	15	Each	$2,500	$37,500
39	Air Sparge Trenching	800	Linear Feet	$25	$20,000
40	Air Sparge Piping	4000	Linear Feet	$2	$8,000
41	Below Ground /Aboveground Piping Connections @ Building	1	Lump Sum	$5,000	$5,000
42	Treatment System Building	1	Lump Sum	$20,000	$20,000
43	HVAC	1	Lump Sum	$5,000	$5,000
44	Electrical Power Drop Wiring	1	Lump Sum	$2,500	$2,500
45	Electrical Panel, Wiring, Lighting System & Electrical Connections	1	Lump Sum	$10,000	$10,000
46	Air Sparging Compressor Package	1	Lump Sum	$7,500	$7,500
47	Pressure & Air flow Gages, Sensors, etc.	1	Lump Sum	$2,500	$2,500
48	Instrumentation & Controls	1	Lump Sum	$15,000	$15,000
49	Misc. Materials and Valves, etc	1	Lump Sum	$3,500	$3,500

Alternative 5 - Limited Source Removal (Landfill) and Groundwater Treatment (Air Sparging)
Remedial Alternative Cost Estimate
Peninsular Gas Company - Plant Site Feasibility Study
Florida Gas Project
Florida Location, Michigan

Item Number	Description	Quantity	Unit	Unit Price	Amount
I	CAPITAL COSTS (Continued)				
	CONSTRUCTION COSTS (Continued)				
	Monitoring Points	--	--	--	--
50	Well Abandonment	11	Each	$1,000	$11,000
51	Groundwater Monitoring Wells	10	Each	$2,000	$20,000
52	Piezometer Monitoring Wells	7	Each	$3,000	$21,000
53	Indoor Air Monitoring Probes	16	Each	$1,250	$20,000
54	Soil Vapor Monitoring Probes	10	Each	$1,250	$12,500
55	Remedial Alternative Verification Sampling Borings	6	Each	$1,000	$6,000
	CONSTRUCTION CONTINGENCY @ 15%				$245,895
	CONSTRUCTION SUBTOTAL				$1,885,195
	ENGINEERING COSTS				
1	Project Management/Administration			$40,000	
2	Pilot Testing			$25,000	
3	Design, Specifications & Contract Documents			$30,000	
4	Permitting and Approvals			$17,500	
5	Deed / Use Restrictions and Property Access			$30,000	
6	Secure Contractors			$10,000	
7	Design & Construction Surveying			$15,000	
8	Construction Observation and Contract Administration			$170,000	
9	Construction Update Progress Reports			$15,000	
10	Treatment System Start-up			$15,000	
11	Construction Documentation Report			$40,000	
12	Health and Safety Plan			$5,000	
13	Environmental Monitoring Plan			$15,000	
14	Storm Water Pollution Prevention Plan			$5,000	
15	Indoor Air Monitoring Plan			$7,500	
16	Treatment System O & M Manual			$5,000	
17	Groundwater/Piezometer Monitoring Well Installation w/ Soil Sampling and Lab			$42,500	
18	Indoor Air Monitoring Probe Installation w/ Soil Sampling and Lab			$27,500	
19	Soil Vapor Monitoring Probe Installation w/ Soil Sampling and Lab			$24,000	
20	Remedial Alternative Verification Sampling			$20,000	
21	Confirmation VSR Sampling Lab			$57,500	
22	Public Involvement Process			$10,000	
	ENGINEERING SUBTOTAL				$626,500
	TOTAL CAPITAL COSTS				$2,761,695
II.	ANNUAL OPERATION AND MAINTENANCE UNIT COST ASSUMPTIONS				
1	Fence Maintenance @ 5 Year Intervals	1,000	Linear Feet	$5	$5,000
2	Fence Maintenance Engineering @ 5 Year Intervals	1	Lump Sum	$2,500	$2,500
5	Groundwater/Piezometer/Air Probe Maint. @ 5 Year Intervals	47	Each	$250	$11,750
6	Groundwater/Piezometer/Air Probe Maint. Eng. @ 5 Year Intervals	1	Lump Sum	$3,000	$3,000
7	Building Vapor Proofing Maintenance @ 5 Year Intervals	1	Lump Sum	$4,000	$4,000
8	Building Vapor Proofing Maintenance Engineering @ 5 Year Intervals	1	Lump Sum	$2,500	$2,500
9	Annual Asphalt Cap Maintenance	1	Lump Sum	$1,500	$1,500
10	Annual Asphalt Cap Maintenance Engineering	1	Lump Sum	$1,000	$1,000
11	Asphalt Cap Sealing @ 5 Year Intervals	1	Lump Sum	$4,000	$4,000
12	Asphalt Cap Sealing Engineering @ 5 Year Intervals	1	Lump Sum	$2,500	$2,500
13	Annual Treatment System Equipment Operation & Maintenance	1	Lump Sum	$2,500	$2,500
14	Annual Treament System Electric Power, Heat & Lighting	1	Lump Sum	$8,000	$8,000
15	Annual Treatment System Opetation, Maintenance, & Sampling Eng.	1	Lump Sum	$7,500	$7,500
16	Soil Vapor Probe Maintenance @ 5 Year Intervals	10	Each	$250	$2,500
17	Soil Vapor Probe Maintenance Engineering @ 5 Year Intervals	1	Lump Sum	$3,000	$3,000
18	Annual Report	1	Lump Sum	$12,500	$12,500

Alternative 5 - Limited Source Removal (Landfill) and Groundwater Treatment (Air Sparging)
Remedial Alternative Cost Estimate
Peninsular Gas Company - Plant Site Feasibility Study
Florida Gas Project
Florida Location, Michigan

Item Number	Description	Quantity	Unit	Unit Price	Amount
III.	ENVIRONMENTAL MONITORING UNIT COST ASSUMPTIONS				
1	Groundwater/Piezometer Monitoring Well Sampling Per Event			$45,000	
2	Groundwater Monitoring Laboratory Per Event			$33,000	
3	Surface Water Monitoring Sampling Per Event			$2,000	
4	Surface Water Monitoring Laboratory Per Event			$3,000	
5	Soil Monitoring Sampling Per Event			$10,000	
6	Soil Monitoring Laboratory Per Event			$8,500	
7	Indoor Air Monitoring Sampling Per Event			$6,000	
8	Indoor Air Monitoring Laboratory Per Event			$5,000	
9	Soil Vapor Monitoring Sampling Per Event			$5,000	
10	Soil Vapor Monitoring Laboratory Per Event			$4,000	
11	Analytical Data Review @ 5 Year Intervals			$5,000	
IV.	FUTURE CLOSURE COST ASSUMPTIONS				
1	Closure Risk Assessment @ 20 Years			$25,000	
2	Closure Request @ 20 Years			$25,000	
V.	PRESENT WORTH ANALYSIS (6.875% DISCOUNT RATE)				
	TOTAL CAPITAL COSTS				$2,761,695
1	Fence Maintenance @ 5 Year Intervals Over 20 Years			$15,080	
2	Groundwater/Piezeometer/Air Probe Maint. @ 5 Year Intervals Over 20 Years			$29,658	
3	Building Vapor Proofing Maintenance @ 5 Year Intervals Over 20 Years			$13,070	
4	Annual Asphalt Cap Maintenance Over 20 Years			$28,401	
5	Asphalt Cap Sealing @ 5 Year Intervals Over 20 Years			$13,070	
6	Annual Treatment System O&M Including Electrical Over 20 Years			$204,489	
7	Soil Vapor Probe Maintenance @ 5 yr Intervals			$8,651	
8	Annual Reports Over 20 Years			$142,006	
	TOTAL OPERATION AND MAINTENANCE COSTS				$454,425
1	Groundwater Monitoring Well Sampling Over 20 Years			$1,499,024	
2	Surface Water Monitoring Sampling Over 20 Years			$96,091	
3	Soil Monitoring Sampling @ 10 Year Intervals Over 20 Years			$15,859	
4	Indoor Air Monitoring Sampling Over 20 Years			$328,917	
5	Soil Vapor Monitoring Sampling Over 20 Years			$193,079	
6	Analytical Data Review @ 5 Year Intervals Over 20 Years			$10,054	
	TOTAL ENVIRONMENTAL MONITORING COSTS				$2,143,024
1	Closure Risk Assessment @ 20 Years			$7,628	
2	Closure Request @ 20 Years			$7,628	
	TOTAL FUTURE COSTS				$15,256
	TOTAL PRESENT WORTH				**$5,374,400**

Note: Groundwater (31 Wells) and surface water (3 Locations) sampling would occur on a quarterly basis for the first 2 years, semi-annually for the next 3 years, and annually thereafter for 20 years. Air monitoring would occur monthly for the first year and then on the same schedule as groundwater and surface water sampling. Soil sampling (10 Locations) would occur every 10 years for 20 years